

Projection Methodology for Future
State Level Volatile Organic Compound
Emissions from Stationary Sources (Version 1.8)

Radian Corp., Research Triangle Park, NC

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a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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Volatility Models		Volatile Organic Com-	20M 12A
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A PROJECTION METHODOLOGY FOR FUTURE
STATE LEVEL VOLATILE ORGANIC COMPOUND
EMISSIONS FROM STATIONARY SOURCES
(VERSION 1.8)

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ABSTRACT

The Volatile Organic Compound Model (VOCM) is one of four stationary source emission and control cost forecasting models developed by EPA's Air and Energy Engineering Research Laboratory for the National Acid Precipitation Assessment Program. The VOCM model projects air pollution emissions (volatile organic compounds) and costs of emission control for 101 point and area source categories by state and year.

This report presents the model framework used to estimate state level and national future volatile organic compound (VOC) emissions and control costs for stationary industrial and utility sources. The framework involves a projection approach using the 1980 NAPAP inventory for VOC emissions aggregated by 101 defined source categories apportioned by ozone attainment and nonattainment areas for each state. The projection approach involves applying expected industry activity factors (growth/decline/replacement rates) and emission constraint factors (environmental control reductions) to the base year emission levels. Future year uncontrolled and controlled VOC emissions and annualized control costs are estimated using annualized control cost values (1980 dollars per ton) for each source category.

The model was developed for use on an IBM personal computer with data input capabilities from mainframe computers containing the NAPAP inventory and industry growth/decline rate data bases. The model has five data files which are interacted to provide uncontrolled/controlled VOC emission projections and cost of controls for:

- any year from 1980 to 2030;
- forty-nine geographic regions (48 contiguous U. S. states and the District of Columbia); and
- 90 industrial/utility point source categories and 11 industrial area sources.

This report was submitted in fulfillment of contract Nos. 68-02-3171, 68-02-3513, and 68-02-3994 by Radian Corporation under the sponsorship of the U. S. Environmental Protection Agency. This report covers the period from September 28, 1983 to September 30, 1987.

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ABBREVIATIONS AND METRIC EQUIVALENTS

ABBREVIATIONS:

Agg	- aggregate
Beg	- beginning
Chg	- change
Const	- constraint
E	- emissions
EE	- existing emission
EM	- emissions
Exclus	- exclusive
GOV	- governing
LOC	- level of control
NE	- new emissions
No	- number
P	- penetration
REG	- region
RE	- replaced emission
REPL	- replaced
RR	- retirement rate
Seg	- segment
Tar	- target
TE	- total emissions
Yr	- year

METRIC EQUIVALENTS:

<u>Nonmetric</u>	<u>Times</u>	<u>Yields Metric</u>
ton	907.2	kg

SECTION 1

INTRODUCTION

This report documents the approach taken for estimating national and state level future volatile organic compound (VOC) emissions and the cost of controlling the emissions from industrial and utility sources. This study, conducted by Radian Corporation, was sponsored by the Environmental Protection Agency (EPA), Air and Energy Engineering Research Laboratory (AEERL), Research Triangle Park, North Carolina, in support of the National Acid Precipitation Assessment Program (NAPAP).

Emissions of VOC may indirectly contribute to acid deposition through participation in atmospheric reactions with NO_x , SO_x , and other pollutants. The reaction products may result in wet (precipitation) or dry acid deposition. For example, it is generally accepted that the presence of ozone (a photochemical reaction product of VOC and NO_x) affects transformation rates of SO_x to sulfates.¹ However, there are indications that the hydrocarbons emitted from natural sources have less impact on air quality than those from man-made sources.² The evidence for these atmospheric reactions is far from conclusive, and the possible chemical reaction mechanisms are not fully understood. If a definite relationship between VOC emissions and acid deposition were established, a VOC control strategy could be considered. Development of a VOC policy would obviously involve analysis of future year VOC emissions and the cost of controls associated with alternative regulatory control strategies.

Under this study, a computer model (VOC Model) was developed that takes data from the 1980 NAPAP emission inventory (Version 3.0) for utility and industrial point and area source emissions and projects future year emission levels by applying expected future activity (growth/decline and retirement/replacement rates) and emission constraints due to existing/future environmental regulations. Base year and future year levels of emission reductions, due to environmental controls, are then multiplied by various control cost effectiveness values to develop the annual costs of emission controls. The VOC Model analytical framework is designed to be

VOC Model analytical framework is designed to be compatible with the other EPA pollutant models on stationary and mobile sources for integration into the overall acid precipitation emission strategy modelling.

APPROACH TO ESTIMATING FUTURE YEAR EMISSIONS AND CONTROL COSTS

The program objectives were to project future VOC emissions and emission control costs by industry category for each of the 48 U. S. contiguous states and the District of Columbia (49 regions). The specific model objectives were to develop a projection approach that would:

- have a simple and flexible framework;
- operate on an IBM personal computer with mainframe computer data input capabilities;
- permit easy updating of data files;
- use a menu-driven structure;
- be consistent with other acid precipitation models; and
- be compatible with NAPAP emission inventory.

The model contains five primary data files which interact with each other, as shown in Figure 1-1.

The base year emissions file contains the NAPAP emissions inventory data aggregated into 90 point source categories and 11 area source categories for the 49 regions. VOC emissions are expressed on an uncontrolled and controlled basis. The model estimates future year uncontrolled emissions by applying the appropriate activity rates found in the replacement rate file and the growth/decline rate file. Replacement rates account for the replacement of existing industry capacity with new capacity due to the retirement of existing equipment. The growth/decline rates account for changes in industrial product/service capacity due to market demand.

Future year controlled emissions are calculated by imposing emission constraints to the projected uncontrolled emissions. These constraints are

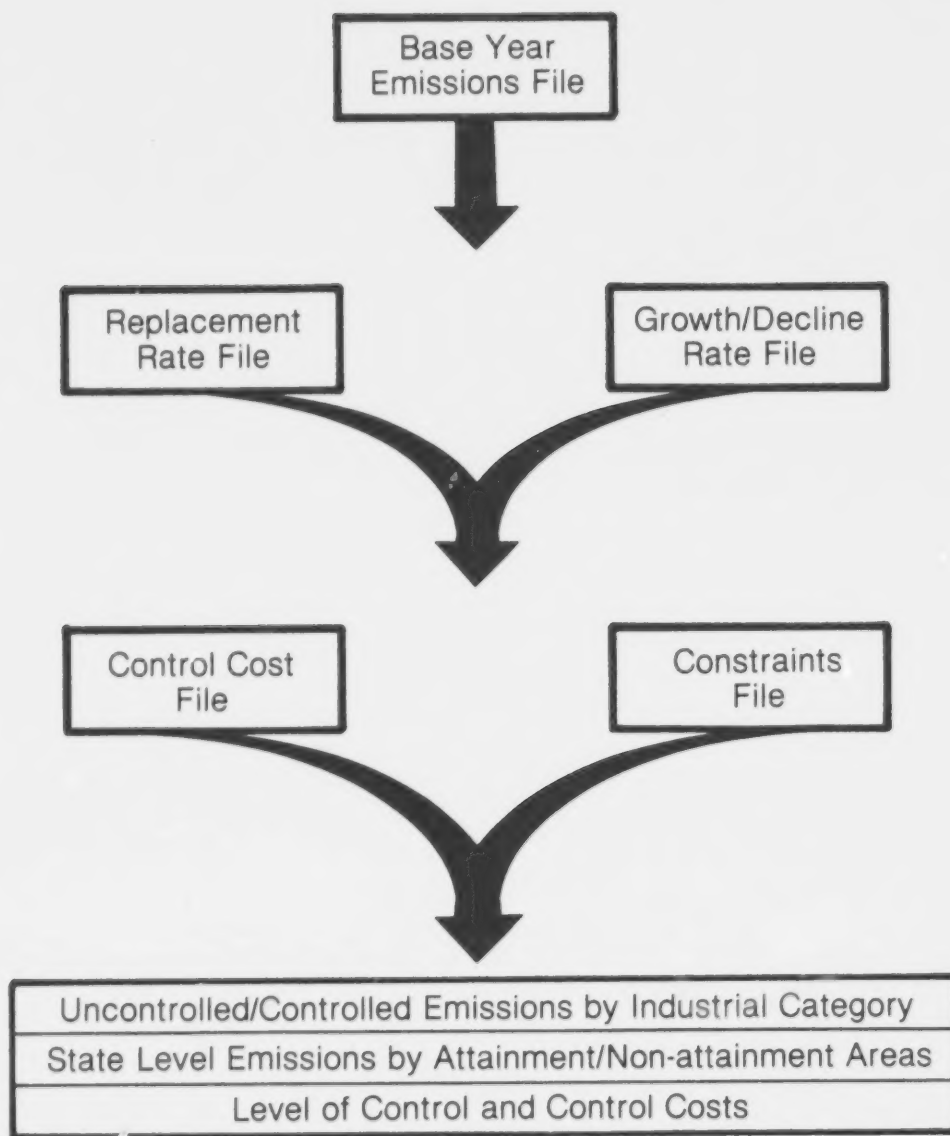


Figure 1-1. VOC Model Framework.

most often due to environmental regulations and this file contains emission reduction factors for the following types of environmental regulations:

- New Source Performance Standards (NSPS) - Best Available Control Technology (BACT);
- State Implementation Plans (SIP) based on Control Technology Guidelines (CTG) - Reasonably Available Control Technology (RACT);
- New source emissions in ozone nonattainment areas - Lowest Achievable Emission Reduction (LAER) control technology;
- Prevention of Significant Deterioration (PSD) - Best Available Control Technology (BACT) economically achievable for new major sources;
- National Emission Standards for Hazardous Air Pollutants (NESHAP); and
- General state regulations mandating 80 to 90 percent control of reactive VOC emissions.

The model outputs the base year and projection year (up to year 2030) uncontrolled/controlled VOC emissions by industry category and region.

Control costs are calculated by applying the amount of controlled VOC emissions (uncontrolled minus controlled emissions) for each industry category times a control cost value (dollars per ton of controlled VOC). The control cost file can contain up to 12 control cost values for each industry category (control cost versus control effectiveness). The model outputs the VOC emission level of control and annualized 1980 dollar cost of controls for each industry category and region.

The model also includes the capability to model emission offsets (additional emission reductions required for new facilities in non-attainment areas) and emission rollbacks (arbitrary restrictions on future emissions specified as a percentage of current emissions). Data for these options can be input into an emission offset/rollback file. However, no development of input data for these options has been done at the time of the writing of this report. Section 2 does discuss the general model framework and the methodology by which a user of VOCM can implement offsets and rollbacks.

REPORT ORGANIZATION

The report sections parallel the model framework. Section 2 discusses in more detail the model framework and the general methodology for developing the program files. Sections 3-6 and the appendices detail what is in each of the model data files.

SECTION 2

FRAMEWORK FOR ESTIMATING FUTURE STATE LEVEL VOC EMISSIONS

This section presents a framework for estimating future VOC emissions from utility and industrial (U/I) point and area sources. The approach is structured for projecting state level emissions using a base year (1980) emissions inventory and applying industry growth rates, retirement/replacement rates and emissions constraints to future year emissions. The framework was developed to provide the basis for a computer model to be run on an IBM personal computer.

Any framework methodology must take into account several parameters all of which are complex in nature. The framework developed here uses 1980 VOC emission data from the NAPAP inventory for utility and industrial point sources and area source emissions. Future emissions are projected from the base year (emissions) by applying the following factors that will impact future emission levels and annualized costs for control:

- New source activity (growth/decline rate),
- Retirement/replacement rate,
- Emission constraints (regulations, technology changes),
and
- Annualized cost of control per ton of VOC by source category.

Figure 2-1 shows schematically how these factors interact to develop a future year estimate of VOC emissions and annualized cost of VOC controlled. Additional options are provided in the methodology for more specialized analyses.

This section includes several sub-sections that provide a general overview of the computational methodology used in the VOC model. Also included are sub-sections that briefly describe the major data files used by the model. Later sections provide details of the data files including the actual contents of each file.

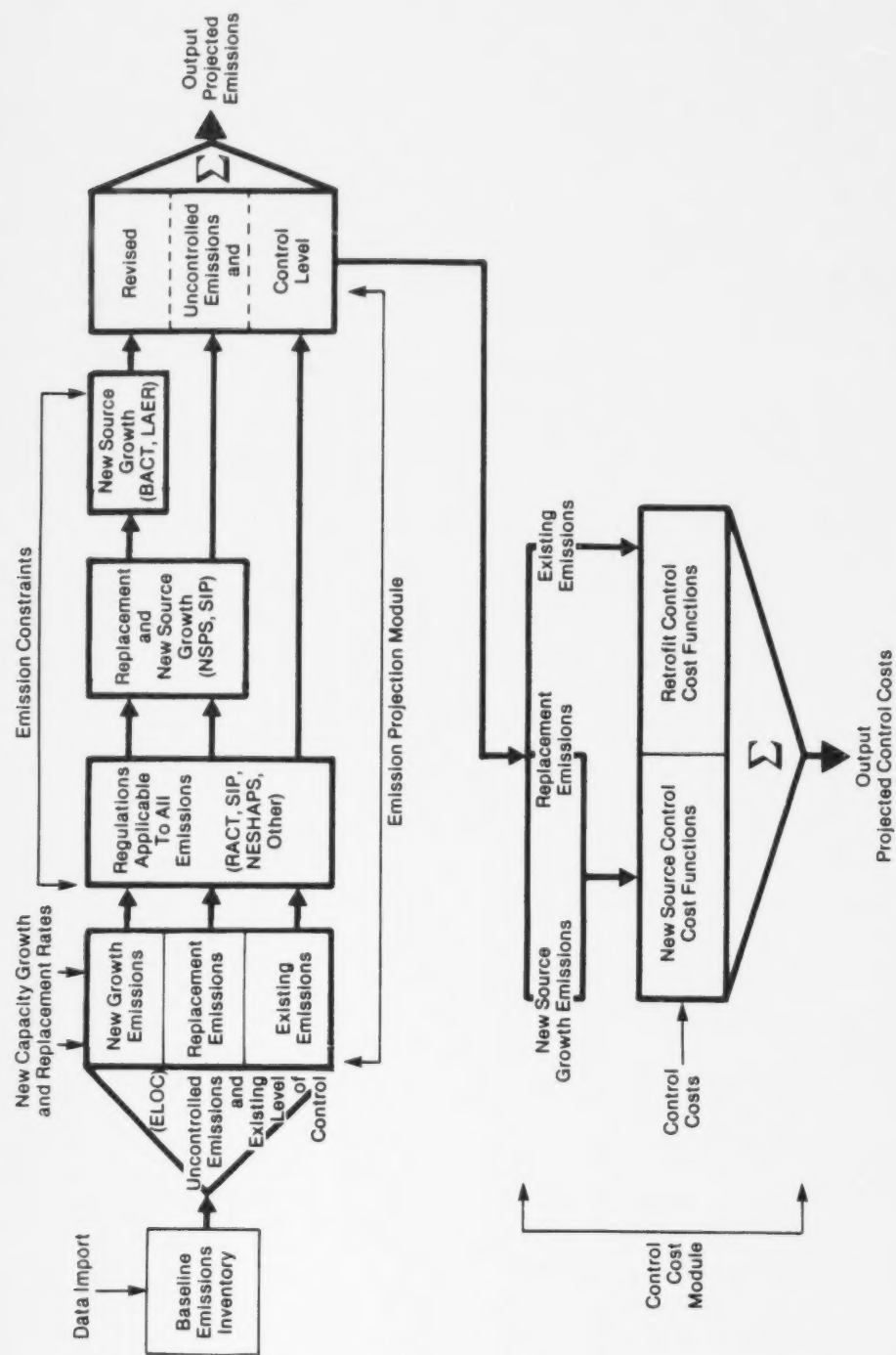


Figure 2-1. Schematic of Radian VOC Model.

BASIC EMISSION PROJECTION METHODOLOGY

The model framework projects emissions for a single industrial category in a single state (defined herein as a sector), and then sums the results for all sectors to arrive at state and national emission estimates. The procedure used by the model to project emissions for a single sector is basically a two-step process:

- First, the base year uncontrolled emissions are projected out to the projection year using the growth rate(s) for the emission sector and a retirement rate for the industrial category represented in the sector. This projection keeps track of the year by year replacement of existing capacity and when new capacity comes on-line for use in the analysis of emission constraints as described below.
- Second, constraints applicable to the emission sector are applied to the uncontrolled emissions to determine controlled emissions. This step requires that the total uncontrolled emissions in the projection be divided into emission "segments" where each segment is subject to a different set of constraints. The timing of when existing capacity is replaced and new emissions come on-line determines the applicability of constraints to each segment.

With respect to any constraint, emissions in the projection year may have existed before the constraint took effect or may have come on-line after the constraint took effect. The model defines these two categories of emissions as follows:

- Existing Emissions - with respect to any constraint, existing emissions (EE) are the emissions in the projection year that existed at the time the constraint took effect. Or, in other words, existing emissions are emissions that have not been retired during the period from the year the constraint took effect to the projection year.

- New Emissions - with respect to any constraint, new emissions (NE) are the emissions in the projection year that did not exist at the time the constraint took effect. Or, in other words, new emissions are emissions that are the result of: 1) the retirement of capacity during the period from the year the constraint took effect to the projection year, or 2) new growth during the period from the year the constraint took effect to the projection year.

Figure 2-2 graphically displays the change in emissions with time for a single constraint. The slope of the line separating existing and new emissions is determined by the retirement rate. A high retirement rate indicates that sources are replaced rapidly and the slope of this line is steep. A low retirement rate indicates that sources are replaced slowly and the slope of this line is gentle. If the retirement rate is zero (indicating that sources are not retired) then this line will be horizontal.

With respect to any constraint, the total emissions are always the sum of existing emissions and new emissions. Therefore, the following equation is true for any projection year "t":

$$TE_t = EE_t + NE_t$$

Total emissions are computed from the base year emissions and the growth rate using a simple exponential growth rate equation:

$$TE_t = BE * (1 + GR)^{(t-by)}$$

where "BE" indicates the base year emissions and "by" indicates the base year. This equation assumes the growth rate is constant throughout the projection period. Actually, the model allows up to seven separate sub-periods to be defined each with a different growth rate. In this case, the model applies this equation for each sub-period with the final emissions from one sub-period forming the base year emissions for the next sub-period.

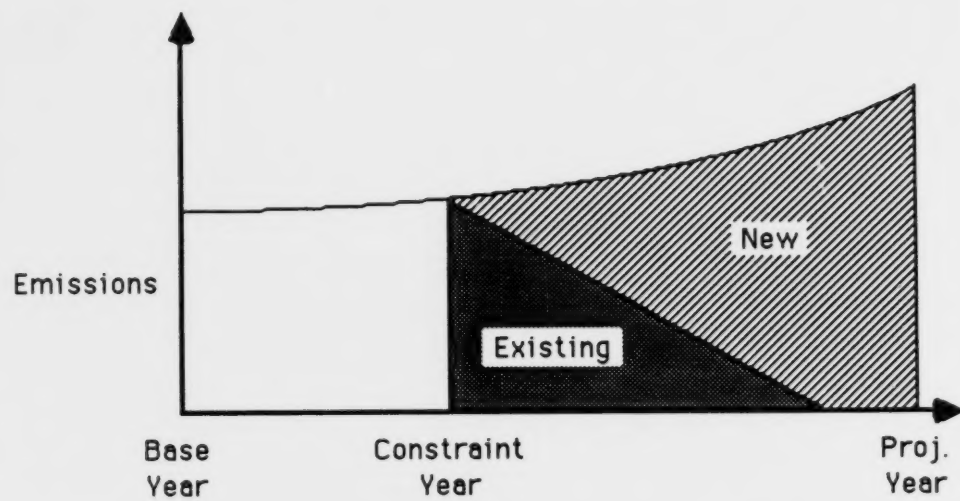


Figure 2-2. Conversion of Emissions from Existing to New.

Existing emissions in the projection year are the emissions that have not been replaced in the period from the year of the constraint to the projection year. They are the total emissions existing in the year of the constraint minus the emissions retired in the period from the year of the constraint to the projection year:

$$EEt = TEcy - (TEcy * RR * (t-cy))$$

where "cy" indicates the year the constraint took effect and "RR" stands for the retirement rate. If the period from the constraint year to the projection year is sufficiently long then existing emissions will become negative. This indicates that all existing emissions have been retired and the model sets existing emissions to zero.

Using the above equations, the model computes total and existing emissions. Since total emissions are the sum of existing and new emissions, the following equation can be used to compute new emissions:

$$NEt = TEt - EEt$$

The preceding equations allow the model to compute uncontrolled emissions in the projection year and to break down these emissions between existing and new emissions for any particular constraint. The complexity of the model arises when more than one constraint is applicable to any sector. (The model allows up to 30 applicable constraints for any sector.) In this case, the model tracks the time applicability of the constraints to different segments of emissions. For example, the Figure 2-3 illustrates a situation where two constraints come on-line at different times. Each constraint is individually applicable to emissions from sources that are new since the time the constraint took effect.

The lines descending linearly from the total emission line indicate the conversion of existing emissions to new emissions. In the projection year, three segments are formed. The segment at the bottom of the diagram represents emissions that existed prior to the year of Constraint A and have

not been retired. Since both Constraint A and Constraint B are applicable only to new emissions, neither constraint is applicable to these emissions. The next segment up represents emissions that have come on-line since Constraint A, but existed prior to Constraint B. Only Constraint A is applicable to these sources. Finally, the top segment represents emissions that have come on-line since both Constraint A and Constraint B. Both constraints are applicable to these emissions.

This example involves constraints that are applicable to new emissions. A similar analysis can be done if the constraints are applicable to existing emissions. In this case, the bottom segment is subject to both Constraint A and Constraint B; the middle segment is subject to Constraint B alone; and the top segment is subject to neither. This type of segment analysis is used by the model for any mixture of constraints applicable to existing or new sources.

Another complication arises in that the model allows the user to define levels of penetration for each constraint. A penetration level indicates what fraction of all sources in a sector are subject to the constraint. Entering a penetration level of less than 100 percent allows for constraints that do not completely cover an entire sector due to exemptions from regulation, lack of enforcement, inapplicability of control technology to all sources, etc.

If only a single constraint is applicable to an emissions segment, then the level of control for the segment is reduced by the penetration of the constraint. For example, if a constraint requires 90 percent control but only 50 percent of the emissions in the segment are subject to the constraint then the overall level of control is based on half the sources being controlled to 90 percent and half being uncontrolled. Thus, the overall level of control for all sources is the level of control multiplied by the penetration, or 45 percent.

If more than a single constraint is applicable to an emissions segment, a penetration analysis is conducted where penetration "bands" are formed. The model assumes that constraints with higher penetrations are applied

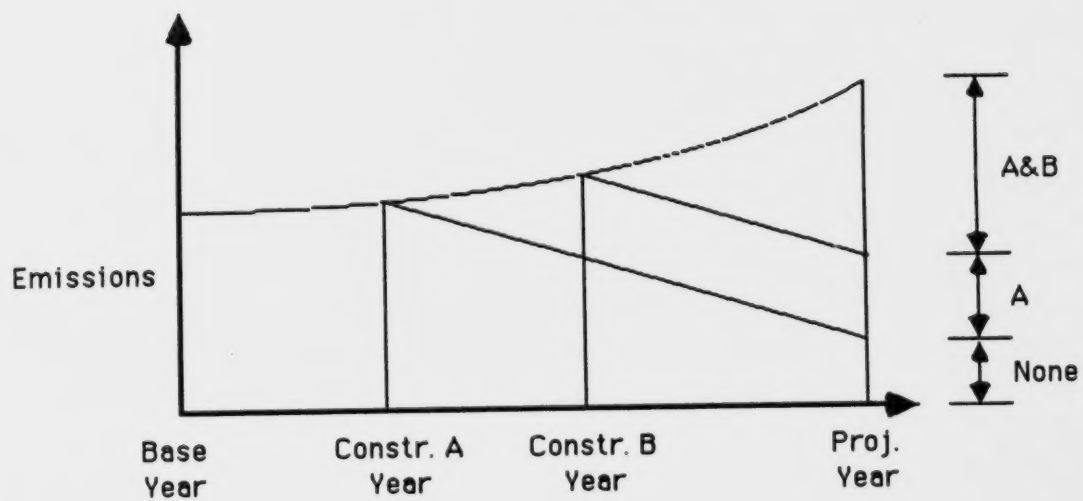


Figure 2-3. Constraint Analysis Involving Two Constraints.

incrementally to sources. For example, Figure 2-4 depicts a situation where three constraints with penetrations of 25, 75, and 100 percent are applicable to a particular emissions segment of 100 tons of uncontrolled emissions. The lowest band of emissions (25 tons/yr) is subject to all three constraints. The middle band of emissions (50 tons/yr) is subject to Constraint B and Constraint C. Finally the upper band of emissions (25 tons/yr) is subject to only Constraint C.

Within each band, the model chooses the constraint with the highest level of control. Typically, constraints with lower levels of penetration (applicable to the fewest number of sources) have the highest level of control. If in the previous example, the levels of control for Constraints A, B, and C were 95, 90, and 75 percent, then the lower band (25 tons/yr) would be controlled to 95 percent, the middle band (50 tons/yr) to 90 percent, and the upper band (25 tons/yr) to 75 percent. Therefore, the total emission reduction is:

$$(25 * 0.95) + (50 * 0.90) + (25 * 0.75) = 87.5 \text{ tons/yr}$$

representing an overall aggregate level of control for the emission segment of 87.5 percent.

EMISSION OFFSET ANALYSIS

The VOC model includes the capability to apply emission offsets to user specified states and industrial categories. Offsets are typically used in non-attainment areas where federal EPA regulations require that new emission sources reduce their controlled emissions to the lowest achievable emission rate (LAER) while obtaining additional emission reductions above and beyond their controlled emissions.

In the model, the user may specify an "offset factor" for each state. This offset factor is the additional emission reduction that new sources are required to obtain above and beyond their own controlled LAER emissions.

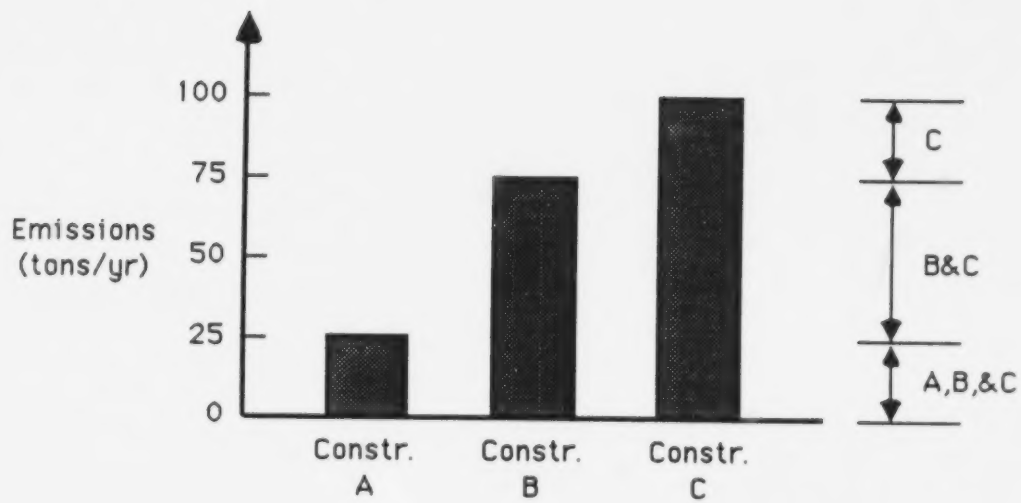


Figure 2-4. Penetration Analysis Example.

For example, an offset factor of ten percent indicates that a new source must obtain offsetting emission reductions from existing sources of their controlled LAER emissions plus an additional ten percent of their controlled emissions. A default value of 20 percent for all states is included in VOCM. A database of offset factors actually implemented in each state is not currently available.

The following steps are conducted by the model during the constraint analysis to implement emissions offsets:

- For each sector, the constraints applicable to the sector are examined to see if any are marked as offset constraints. If so, the model looks up the offset factor for the state in a rollback/offset file (rollbacks are described later).
- During the penetration analysis, all constraints that are applicable to each penetration band are examined to see if any are offset constraints. (Typically, offset constraints are the most stringent constraint for any particular industrial category since they represent LAER control technology, however, this is not required by the model.) If an offset constraint is noted, then the aggregate level of control computed for the penetration band is adjusted to a higher level of control to account for the offsetting emissions that must be obtained.

Offsets cause the level of control for penetration bands containing offset constraints to be greater than 100 percent and the emissions from the band to be negative. These negative emissions must be offset from other emission bands and segments that are not subject to offsets. The most common situation is where existing emissions do not have offset constraints applicable and thus can supply the offsetting emissions. However, in some cases offsets will cause the sum total of all emissions from a sector to be negative. In this case, the model sets the emissions to zero.

It is important to note that the model implements offsets by increasing the overall level of control for any sector. This means that offsets are always obtained from other sources in the same industrial category - obtaining offsets from another industrial category is not allowed. This limitation is inherent in this way of modeling offsets.

EMISSION ROLLBACKS

The VOC model implements a method to allow for emission rollbacks in any state or states. Rollbacks are user specified emission ceilings expressed as a fraction of emissions in any specified year. For example, a rollback year of 1990 can be specified for a state with a rollback level of 75 percent. If the model was run with a projection year of 1995, the model would automatically limit the total controlled emissions for each sector in the state to 75 percent of the predicted emissions in 1990.

Rollbacks are implemented by running two analyses: one analysis for the rollback year and another for the projection year. An emission ceiling is then established by multiplying the rollback year controlled emissions by the state rollback level. The model then checks to see if the projection year controlled emissions exceed this ceiling. If so, then the projection year controlled emissions are set to the ceiling; otherwise, the projected year emissions are left unchanged.

CONTROL COST ESTIMATION

The VOC model can provide estimates of the costs of control in the projection year. This is done by:

- Computing the overall level of control for a sector based on the uncontrolled and controlled emissions in the projection year.
- Using this level of control to interpolate a cost per ton of VOC controlled in control cost tables specified by the user. Control cost tables define a relationship between level of control and the

cost of VOC removed for any particular industrial category. Up to 12 points (percent removal vs. \$/ton of VOC controlled) can be specified in a relationship. The model interpolates for levels of control that are not explicitly represented in the table.

- The tons of VOC controlled are multiplied by the cost per ton to arrive at a final control cost for the sector.

INDUSTRIAL CATEGORIES

NAPAP has developed a data base for use in developing sound policy initiative and mitigation strategies for acid precipitation. The NAPAP data base was developed from EPA's National Emission Data System (NEDS) which is broadly divided into point source information and area source information. Point source data are associated with larger, stationary emitters of air pollutants, while area source data are associated with mobile sources and small stationary emitters. For both data bases, the point sources are organized by source classification codes (SCC) and geographical area. Area sources are organized into source categories and labeled with code numbers from the Aerometric and Emissions Reporting System (AEROS) manual. The following subsections discuss how the NAPAP point and area source data was aggregated for use in the VOC Model.

Point Source Categories

Nationally, in 1980, there were over 80,000 VOC emitters considered as U/I point sources, located in almost 21,000 plants.³ At the state level, VOC point source populations range from about 100 to over 18,000. Also, there may be multiple SCC's for each emission point within a plant. For the scope of this project, these overwhelming numbers of sources prohibited state level estimates of future VOC emissions based on direct scale-up of individual source data. However, source data can be aggregated into a manageable number of industry groups or industrial categories based on some common process characteristics and environmental regulations which are

generally targeted at specific SCC codes (industries). For example, if sources were grouped by process characteristics, VOC sources could be grouped into as few as 15 major point source categories:

- | | |
|---|----------------------------------|
| 1. Petroleum Refining | 8. Degreasing Operations |
| 2. Petroleum Products Storage/
Marketing | 9. Graphic Arts |
| 3. Misc. Chemical Manufacture | 10. Misc. Industrial Processes |
| 4. Iron & Steel Manufacture | 11. External Combustion Boilers |
| 5. Mineral Products Manufacture | 12. Misc. Solvent Users |
| 6. In-Process Fuel Use | 13. Plastic Products Manufacture |
| 7. Industrial Surface Coating | 14. Crude Oil & Nat. Gas Prod. |
| | 15. Textile Products |

An EPA emissions inventory (NECRMP) of the 15 northeastern states revealed that the first eleven categories accounted for 84 percent of the VOC emitted by point sources.⁴ However, VOC regulations are quite specific in coverage of only segments of major industrial categories. So, direct application of regulations and other VOC emission impact factors requires division of the major categories into further defined sub-categories for point sources. In addition, area source categories need to be defined.

About 70 VOC industrial categories have been targeted through current and developing Federal Regulations (NSPS, NESHAP, and CTG). Some of these source categories are quite large, consisting of miscellaneous broad ranges of sources and not all source categories are specifically targeted by federal regulations. Additionally, some of the regulated source categories are more specific than the categories allocated by NEDS. For example, EPA has not assigned specific SCC codes for the following VOC regulatory areas:

- Benzene fugitives - petroleum refineries
- Benzene fugitives - SOCFI
- Benzene storage
- Industrial surface coating - beverage cans
- Industrial surface coating - magnetic tapes
- Industrial surface coating - pressure sensitive tapes and labels
- Industrial surface coating - recreational vehicles
- Industrial surface coating - vinyl/urethane film: rotogravure presses

- Industrial surface coating - elastomeric coating of fabrics
- Industrial surface coating - plastic parts for business machines
- Graphic arts - printing on paper, film, & foil

A total of 90 industrial categories were selected as a recommended list for VOC point source emission projections. Unassigned regulatory areas were combined with related categories defined by SCC's. The point source list consists of industrial processes, utility and industrial combustion sources, storage facilities, and industrial waste disposal operations. Although dry cleaning is included in this list, it should not be used for this projection since it is a commercial and residential source. Appendix A presents the SCC codes that make up each of the 90 point source categories.

Area Source Categories

The AEROS Manual has defined 64 area source emission categories in NEDS which are not assigned SCC codes.⁵ Eleven of these area sources were considered as industrial emission sources and are included in the VOC Model. Ten of these area source categories are for industrial combustion sources and one covers solvents purchased for industrial use. It is difficult to break out solvents purchased for industrial use from commercial and residential sources, so this category can only be approximated. Appendix A shows the AEROS Manual codes represented by the 11 area source categories.

REPLACEMENT AND NEW SOURCE GROWTH

Future VOC emissions from industrial categories are impacted by the construction/operation of new facilities. Economic justification for new facilities is a function of an increase in product/service demand and replacement of existing facilities. The VOC emission projection model calculates the increase in new source uncontrolled emissions by applying growth/replacement factors to the base year uncontrolled emissions. Each of these factors are discussed in general below.

Replacement Rate

Replacement factors account for modifications, reconstructions, and replacement of existing sources (no increase in production/service capacity). The capacity replacement occurs due to the technologic obsolescence of the existing equipment and/or its physical deterioration. Because all equipment has a finite operating life, in future years the emissions from existing sources decreases to zero. The rate at which this occurs varies from industry to industry but typically ranges from 5 to 30 years.

Many factors impact the decision to retire/replace existing capacity. Therefore, the model allows the user to input the fraction of existing uncontrolled emissions which are retired on an annual basis for each industrial category. The uncontrolled emissions from replaced existing facilities are treated as new source emissions.

New Source Growth Rate

Obviously, any model developed to project future VOC emissions must account for changes in future emissions due to new industrial capacity. This is particularly important from an environmental regulation standpoint because regulations are typically much more stringent on new source emissions than for existing source emissions. New source emissions are required to employ BACT and in non-attainment areas LAER control technology. The model framework allows the user to project new source uncontrolled emissions by increasing/decreasing base year uncontrolled emissions using an annual growth rate. These annual rates can be negative or positive for an industrial category.

The new source growth rates for each industrial category were developed by Argonne National Laboratories in support of NAPAP emission model development efforts. Three growth rate scenarios were developed (low, medium, high) for each industrial category (101) for 49 state/region (48 contiguous states plus District of Columbia) for each of the following years:

- | | | |
|------------------|------------------|------------------|
| - 1980 thru 1985 | - 1996 thru 2000 | |
| - 1986 thru 1990 | - 2001 thru 2010 | - 2021 thru 2030 |
| - 1991 thru 1995 | - 2011 thru 2020 | |

EMISSION CONSTRAINTS

Emission constraint factors addressed by this project are primarily those related to environmental regulations. However, the model framework lends itself to input of other types of constraints such as technological development.

Environmental Regulations

Federal, state, and local environmental regulations affect emissions from many VOC sources. However, local ordinances are not considered a major factor. Local standards tend to be duplicates of state standards or specific to certain plant sites and are too cumbersome to include in a national emission analysis on a state-by-state basis. Only in specific instances are local regulations important, e.g., VOC regulations in the Los Angeles metropolitan area. Although local regulations are not now included, the model does allow for their inclusion in the future. VOC sources in a number of industries are covered by Federal regulations and State Implementation Plans (SIP's). However, many sources are affected by only one regulatory authority, and still other sources are not affected at all. The control levels established under the two sets of regulations tend to be somewhat different. In general, Federal standards are more stringent than state standards. On the other hand, states with severe ozone problems may justify more strict VOC emission levels.

Federal Regulations--

Two sets of Federal regulations developed by EPA affect sources of VOC emissions: New Source Performance Standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAP). The first VOC NSPS was proposed in 1973 and since that time twenty-two have been proposed/promulgated, two have been revised and another eight are slated for proposal in 1985 and 1986. NSPS regulations affect specific industrial sources that store, handle, process and/or use volatile organic compounds. Since 1976 two NESHAP regulations have been proposed/promulgated for vinyl chloride from vinyl chloride manufacturers and end user processes and benzene from petroleum refining and SOGMI facilities.

For NSPS regulations, source status determines applicability. The distinction between "new sources" and "existing sources" within a targeted point source category is determined by the proposal date of Federal regulations. Some sources of a targeted category may be considered as "exempt sources" under the Federal regulations, for various reasons, but may still be subject to state regulations. Also, when Federal regulations are revised, "new sources" after the revision proposal date are affected. However, "new sources" constructed before the revision continue to be subject only to the promulgated regulation for the initial proposal. Thus, a progression of "new source" applicability status can occur in some source categories affected by several revisions of Federal regulations. NESHAP regulations are directed at specific toxic compounds.

State Regulations--

Most states have VOC regulations that are similar to federal standards or guidelines. States with ozone non-attainment areas must develop VOC regulations reflecting reasonably available control technologies (RACT) for existing sources covered by Control Technology Guidelines (CTG) documents issued by EPA. These states must submit the RACT regulations for EPA approval by January 1st of each year for those CTG's that were published before January 1st of the previous year. Over twenty CTG's have been published with others planned.

The geographic coverage of the RACT regulations varies from state-to-state and may include city/county regions that are not considered as non-attainment areas by EPA. Sixteen states apply RACT statewide even though some attainment areas exist. Nine states have no RACT regulations by approval of EPA. The remaining states have non-uniform geographic RACT coverage, generally including only non-attainment regions. For most states, the primary ozone attainment date was 1982. However, attainment in the more industrialized regions has been delayed until 1987.

New sources of VOC emissions in non-attainment areas can be subject to EPA's "Bubble Policy" or the "Dual Source Policy". This policy requires the lowest achievable emission rate (LAER) control technology must be applied

and any increase in emissions must be offset by emission reductions for the non-attainment area. EPA has published LAER guidance for twelve VOC source categories. EPA also publishes a document of LAER determinations which is periodically updated to help states develop LAER levels.

New major sources and significant modifications which fall under EPA's Prevention of Significant Deterioration (PSD) regulations must apply best available control technology (BACT). This regulation ensures that air quality in state attainment areas does not deteriorate to non-attainment status due to new emission sources. EPA also publishes BACT determinations to help states set BACT levels.

In addition to the above state VOC regulations which are mandated by federal regulations, numerous states have developed general VOC regulations covering use of "photochemically reactive" solvents. These regulations require 80 to 90 percent control of "reactive VOC emissions" in non-attainment areas and attainment areas in some case.

Technologic/Economical Process Changes

Industry trends not directly affected by environment regulations can result in a reduction of VOC emissions from industrial categories. These trends can be technology changes or changes as a result of raw material/product costs. Process technology improvements in the areas of raw material changes and process efficiency improvements can result in VOC emission reductions. For example surface coating industry trends are away from organic solvent based coatings to water based coatings and improved process controls which reduce the amount of coating applied to surfaces. For industry in general, the significant increase in the price of petroleum has resulted in economic trends away from petroleum based raw materials and an increased effort to reduce loss of petroleum solvents and products. In many cases these trends are incorporated in the standards setting process and become part of the emission reduction credits and economic justification for NSPS.

SECTION 3

VOC EMISSION DATA BASE

The VOC emission data file for the utility/industrial sector includes point sources and area sources. The data base was developed from the 1980 NAPAP point and area source emission inventories (Version 3.0). The following subsections describes what information is contained in the VOC Model emission data file and the methodology used to obtain/derive the data.

Point Source Categories

The NAPAP inventory contains VOC emission data for point sources by point (stack) and by SCC code. The emissions recorded are plant estimates for controlled VOC emissions. However, the VOC Model projects future year emissions by using uncontrolled emissions estimates for industrial categories which are aggregates of SCC codes. Consequently, it was necessary to calculate the uncontrolled emissions for each SCC source using the data provided for each point source in the NAPAP inventory.

To accomplish this, the NAPAP inventory point and SCC record data were loaded into an IBM-PC disk file. Figure 3-1 schematically shows the steps taken to download the NAPAP emission inventory from a mainframe computer onto IBM-PC disk files and aggregate the data into the 90 point source categories for the 48 contiguous states and D.C. The emission data in the VOC Model emissions file are stored in the region/category matrix presented in Figure 3-2.

The steps required to create the emissions matrix are:

- Back calculate uncontrolled emissions for each point source based on NAPAP data base emission estimate (controlled) and control device efficiency,
- Determine percentage of uncontrolled emissions contributed by each process tied to the source points, and
- Allocate controlled/uncontrolled point source emissions to the 90 industrial categories by SCC codes.

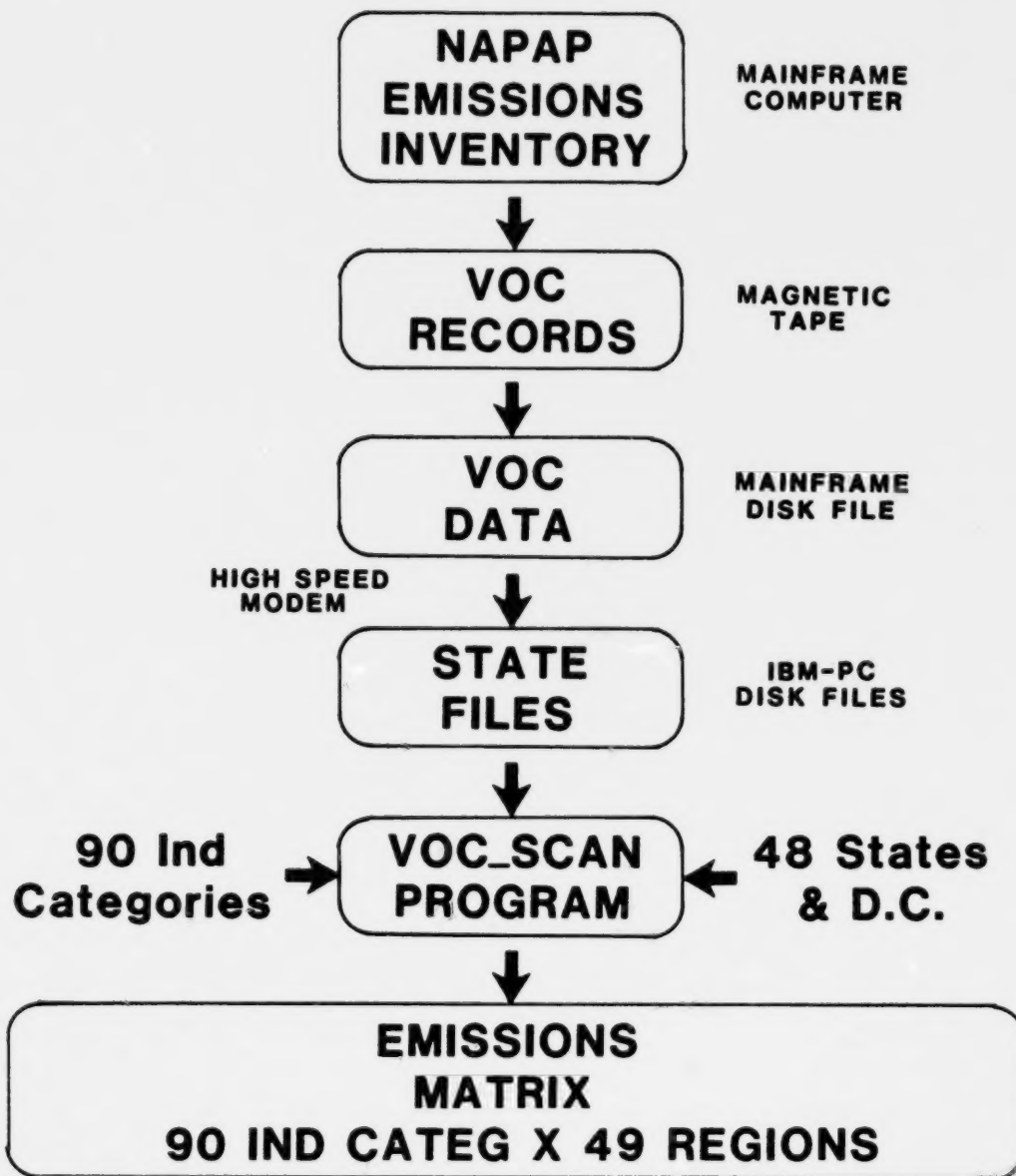


Figure 3-1. Data Reductions.

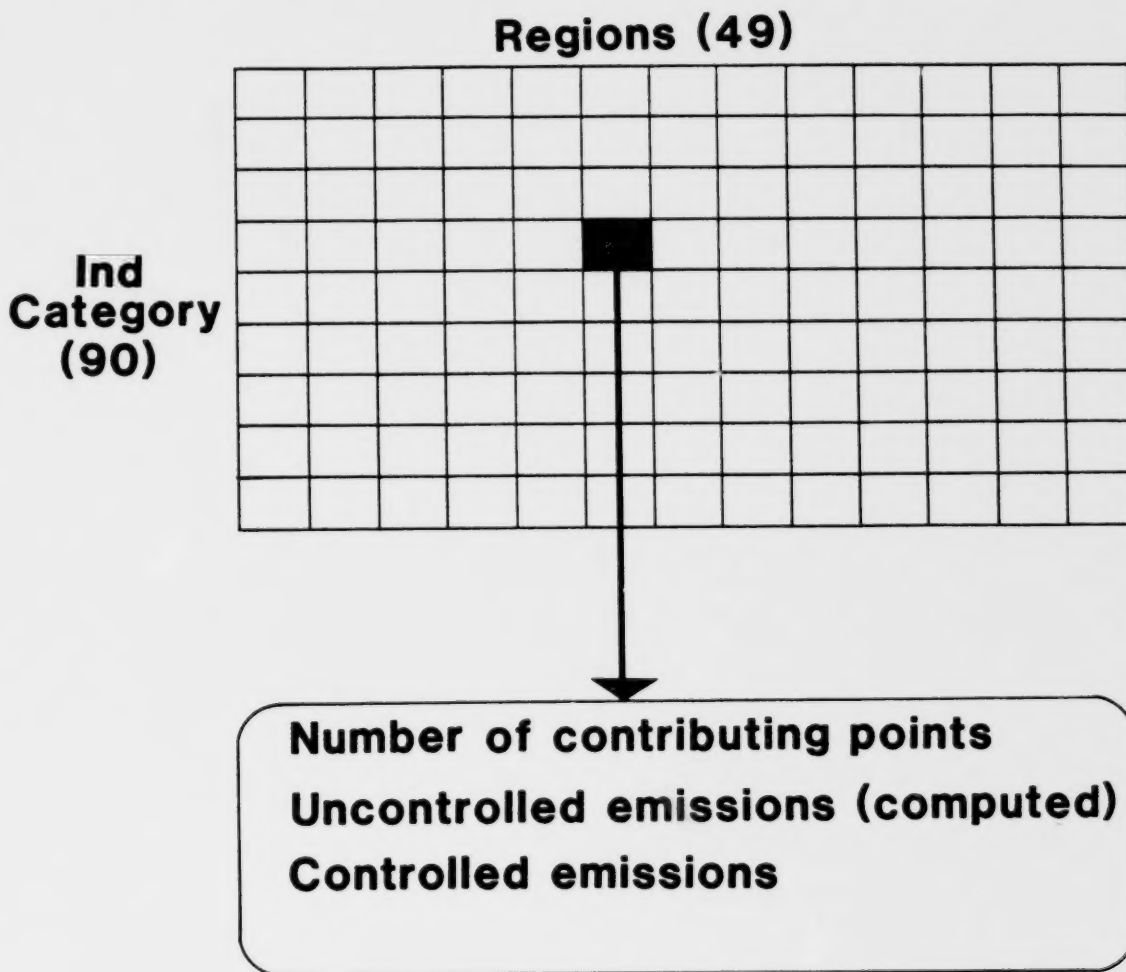


Figure 3-2. Region/Category Matrix.

Table B-1, Appendix B presents the results of this emission database development effort for the VOC Model emissions file.

Area Source Categories

Eleven area source categories were identified as industrial source emitters of VOC emissions from the NAPAP inventory:

- Small industrial combustion sources using anthracite coal;
- Small industrial combustion sources using bituminous coal;
- Small industrial combustion sources using coke;
- Small industrial combustion sources using distillate oil;
- Small industrial combustion sources using residual oil;
- Small industrial combustion sources using natural gas;
- Small industrial combustion sources using wood;
- Small industrial combustion sources using process gas;
- Industrial onsite incineration;
- Industrial open burning; and
- Industrial solvent purchase/use.

Table B-1, Appendix B, presents the area source emissions used in the model emissions file.

For all but the solvent purchase category, VOC emissions by state were taken directly from the NAPAP inventory (Version 3.0). These emissions were divided into attainment/non-attainment categories using the statewide categories split for all point source categories.

The industrial purchased solvents were estimated using 1981 NEDS data developed by the National Air Data Branch of EPA's Monitoring Data and Analysis Division. These data are categorized by industrial and non-industrial sources. The 1981 industrial purchases and industrial component of the non-industrial others category were adjusted to 1980 levels by multiplying each state's 1981 emission level by the 1980 emission level, and then divided by the 1981 national level. These emissions were combined to estimate the 1980 solvent purchased-industrial category.

The VOCM model baseline emissions data (1980) were produced by compiling data from Version 3.0 of the NAPAP 1980 emissions inventory. Since the time these data files were developed, Version 3.0 of the NAPAP 1980 emissions inventory has been upgraded to Version 5.0 based on correction of errors in estimates of the fuel use (principally natural gas) and purchased solvent use. These changes reduced 1980 emission estimates for several categories.

The VOCM data files have not been updated to include Version 5.0 emission inventory. Instead, the files will be updated to the 1985 NAPAP emissions inventory as they become available. This course of action was selected since the 1985 emissions inventory data are expected to have greater accuracy than the 1980 data base, the compilation of emission inventory data into VOCM emissions data files is resource intensive, and the model can be concurrently updated to a more recent baseline (i.e., 1985).

Until revised VOCM emission data files are produced, the user should keep in mind that the net effect of the revisions to the 1980 NAPAP emissions inventory (i.e., Version 5.0) on the VOCM emission estimates is to reduce 1980 VOC emission estimates by approximately 707,000 ton for natural gas fuel use sources and by approximately 606,000 tons for solvent purchase/use sources in comparison to the baseline 1980 emissions built into the current data files supplied with Version 1.8 of the VOCM model.

SECTION 4

REPLACEMENT AND GROWTH RATE DATA BASE

To estimate future VOC emissions, the VOC Model multiplies the 1980 uncontrolled emissions for each source category times replacement/growth rate factors to project future year uncontrolled VOC emissions. Separate VOC Model files contain these annualized factors and the following subsections describe how these factors were derived.

Replacement Rate File

As previously discussed, existing industry facilities are periodically replaced due to technologic obsolescence and/or physical deterioration of equipment. Many factors impact the economic decision to replace existing capacity, and replacement rates vary from industry to industry. Table 4-1 shows the annualized industry replacement factors used by the VOC Model and the I.R.S. average depreciation period.⁶ These replacement factors are based on the assumption that the operating life of a piece of equipment is twice the I.R.S. allowable depreciation life. The annualized replacement factor for each industry category was taken as the reciprocal of twice the I.R.S. allowable depreciation life (straight line replacement rate). The replacement rates for each source category were assumed to be the same for all regions. Some industries are represented in more than one I.R.S. category. When this occurred, the average replacement rate was used. Approximately one-third of the point source categories and all of the area source categories are not shown in Table 4-1 because no I.R.S. depreciation values were available. For each of these categories, a default value of 0.033 (15 year I.R.S depreciation period) was entered in the file. At this time, there are no constraints on area sources, so changing replacement rates does not affect results for area sources.

For projecting future year existing VOC emissions, the VOC Model subtracts from the base year existing uncontrolled VOC emissions at an annual rate equivalent to the replacement factor. Consequently, the existing uncontrolled emissions decrease to zero at a time period equal to

TABLE 4-1. INTERNAL REVENUE SERVICE DEPRECIATION GUIDELINES
FOR VOC INDUSTRY EQUIPMENT

Source ^a Category	Sources ^b	Average Depreciation Period, Years	Annual Replacement Rate Factor
1-2	Exploration for & Production of Petroleum & Natural Gas Deposits & Storage	14	0.036
2	Natural Gas Production Plant	14	0.036
2	Liquified Natural Gas Plant (& Storage)	22	0.022
3 - 14	Petroleum Refining of Crude Petroleum	16	0.031
19 - 33	SOCMI	10	0.050
39	Manufacture of Vegetable Oils/Vegetable Products	18	0.028
40 & 74	Manufacture of Finished Plastic Parts	11	0.045
40 & 74	Manufacture of Basic Plastic Parts, Phonograph, Records, Motion Picture Films & Tapes, Pens, etc.	12	0.042
41 & 42	Manufacture of Rubber Products	14	0.036
44 & 46	Manufacture of Primary Steel Mill Products	15	0.033
47	Manufacture of Primary Nonferrous Metals	14	0.036
47	Manufacture of Electronic Components	6	0.083
47 & 73	Manufacture of Electrical & Non-Electrical Machines, and Other Mechanical Products	10	0.050
50	Manufacture of Tobacco & Tobacco Products	15	0.033
51 & 67	Manufacture of Other Food Products & Beverages	12	0.042
52	Manufacture of Leather & Products	11	0.045

(continued)

TABLE 4-1. (Continued)

Source ^a Category	Sources ^b	Average Depreciation Period, Years	Annual Replacement Rate Factor
52 & 70	Manufacture of Yarn, Thread, & Woven Fabric (Includes Tire Fabric & Ind. Belts)	11	0.045
54	Manufacture of Pulp & Paper	13	0.038
54	Manufacture of Converted Paper, Paperboard & Pulp Products (i.e., for bags, envelopes, etc.)	10	0.050
55	Manufacture of Glass Products	14	0.036
55	Manufacture of Stone & Clay Products	15	0.033
60	Mining equipment for Sand, Gravel, and Minerals	10	0.050
60	Manufacture and Production of Substitute Natural Gas - Coal Gasification	18	0.028
65, 67, 68, 71, & 73	Manufacture of Fabricated Metal Products (i.e., cans, tinwire, etc.)	12	0.042
66	Manufacture of Motor Vehicles	12	0.042
72 & 73	Manufacture of Wood Products & Furniture	10	0.050
73	Manufacture of Locomotives & Railroad Cars	12	0.042
75	Ship and Boat Building Machinery and Equipment	12	0.042
76	Manufacture of Aerospace Products	10	0.050
78 & 82	Graphic Arts Industry	11	0.045
84	Utility - Electric Steam Production Equipment	28	0.018

(continued)

TABLE 4-1. (Continued)

Source ^a Category	Sources ^b	Average Depreciation Period, Years	Annual Replacement Rate Factor
85 & 87	Industrial-Steam & Electric Generation Equipment	22	0.023
87	Electric Utility Combustion Turbine	20	0.025

^aSee TABLE A-1 (Appendix A)

^bSOCMI - synthetic organic chemical manufacturing industry, including plastic film, non-woven fabrics, and photographic film/paper.

^cReciprocal of two times the depreciation period in years based on EPA Guidelines for Air Quality Maintenance Planning and Analysis - Projecting County Emissions (EPA-450/4-74-008).

two times the I.R.S. depreciation life. Replacement emissions are handled by the model as a separate category of emissions and are treated as new source emissions. These emissions and new source emissions are not replaced in future years. The model assumes that all existing emissions are retired and replaced unless the existing emissions have already been reduced by a negative growth rate.

Growth Rate File

Future VOC emission growth rates for each source category were developed by Argonne National Laboratories (ANL) in support of all NAPAP emission model development. The ANL growth rates are based on SIC codes. Table 4-2 shows the SIC's for each industrial category for all regions and the percent of uncontrolled emissions contributed by each SIC. This table and a similar table for each of the 49 regions was used by ANL to proportion regional SIC growth rates to each industrial point source category. ANL used projected energy growth rates for area sources 91 through 98 and general economic growth rates for area sources 99, 100, and 101.

The SIC weightings for each industrial category were derived from the NAPAP inventory point records. For each region/category, emissions are divided between three four-digit SIC's and one two-digit SIC. If these four SIC categories do not account for all the emissions, the remaining fraction is assigned to an industry average growth rate factor. Table 4-2 shows for each industry category the percentage of emissions which fall under the four SIC categories and the residual percentage for all regions.

The VOC Model growth rate file will contain growth rates for each source category for each region and the all region composite. Growth rates for seven differing time periods are provided:

- | | |
|------------------|------------------|
| - 1980 thru 1985 | - 2001 thru 2010 |
| - 1986 thru 1990 | - 2011 thru 2020 |
| - 1991 thru 1995 | - 2021 thru 2030 |
| - 1996 thru 2000 | |

TABLE 4-2. POINT SOURCE CATEGORY SIC CODES

Ind. Cat.	1st SIC		2nd SIC		3rd SIC		4th SIC		Remaining
0	9711	24.1	4953	14.4	7216	5.6	72	5.3	50.6
1	2911	76.4	1311	23.6	0	0.0	0	0.0	-0.0
2	1311	91.1	1321	7.6	2813	1.2	29	0.1	-0.0
3	5171	63.5	2911	25.0	4612	4.0	46	2.0	5.5
4	2911	63.6	4612	15.6	5171	8.5	49	5.5	6.7
5	2911	43.3	5171	38.6	4612	4.8	13	3.0	10.3
6	2911	91.0	2951	4.4	5171	2.8	28	1.5	0.3
7	5171	85.0	2911	11.2	1321	1.0	28	0.9	1.9
8	2911	93.8	1311	3.5	1381	1.4	51	0.6	0.7
9	2911	96.9	1321	1.1	2879	1.0	28	0.5	0.5
10	2911	99.9	4613	0.1	0	0.0	0	0.0	0.0
11	2911	100.0	1321	0.0	0	0.0	0	0.0	0.0
12	2911	75.2	2951	15.8	3273	4.5	29	3.6	1.0
13	2911	100.0	0	0.0	0	0.0	0	0.0	0.0
14	2911	98.9	1311	0.8	1321	0.1	28	0.1	0.1
15	5161	68.3	2911	18.5	5171	4.1	28	5.6	3.5
16	5171	34.6	2811	20.2	2823	14.8	28	13.4	17.0
17	5171	51.8	2911	15.9	9711	13.7	46	10.8	7.7
18	2999	100.0	0	0.0	0	0.0	0	0.0	0.0
19	2821	84.6	5161	13.7	2869	1.7	0	0.0	-0.0
20	2873	67.1	3573	18.3	2421	5.2	28	7.3	2.1
21	2869	100.0	0	0.0	0	0.0	0	0.0	-0.0
22	2869	100.0	0	0.0	0	0.0	0	0.0	0.0
23	2869	68.7	2821	30.0	3011	0.6	30	0.5	0.2
24	2821	68.7	2865	21.6	2911	4.4	24	2.9	2.5
25	2865	100.0	2869	0.0	0	0.0	0	0.0	-0.0
26	2869	93.0	2823	3.8	2865	1.9	28	1.1	0.2
27	2821	100.0	2822	0.0	2865	0.0	26	0.0	0.0
28	2821	99.7	3613	0.1	7391	0.1	28	0.1	0.0
29	2869	95.0	2865	2.4	2992	2.1	28	0.5	0.0
30	2869	39.2	2821	39.1	2865	20.2	29	1.5	0.0
31	2895	95.0	2899	4.7	1311	0.3	32	0.0	0.0
32	3079	15.0	3714	13.2	2641	8.4	28	11.4	52.0
33	2869	54.9	2824	12.5	2818	12.4	28	18.2	1.9
34	0	77.0	2834	21.1	2833	1.9	28	0.0	0.0
35	2824	84.4	2821	6.2	2823	3.1	22	4.6	1.6
36	2823	98.8	2824	0.9	2261	0.3	0	0.1	0.0
37	2819	53.9	2873	26.4	2869	7.1	28	9.6	3.0
38	2085	96.2	2083	1.4	2082	1.1	20	0.8	0.5
39	2048	99.5	2074	0.2	2042	0.2	20	0.1	0.0
40	3079	55.5	2641	34.5	2952	7.6	30	1.6	0.8
41	3011	98.6	2822	1.4	3537	0.0	75	0.0	0.0
42	2822	97.7	3011	0.7	2821	0.6	28	0.6	0.4
43	2892	37.1	2869	36.3	2851	5.9	28	18.6	2.1
44	3312	90.7	0	3.8	3310	3.5	28	1.0	1.0
45	0	0.0	0	0.0	0	0.0	0	0.0	0.0

TABLE 4-2. POINT SOURCE CATEGORY SIC CODES (Continued)

Ind. Cat.	1st SIC		2nd SIC		3rd SIC		4th SIC		Remaining
46	3312	74.8	3321	10.5	3310	6.3	50	4.6	3.8
47	3353	14.5	3321	13.1	3497	12.9	33	29.3	30.5
48	3494	99.4	3462	0.6	0	0.0	0	0.0	-0.0
49	3411	32.3	3621	19.8	3441	11.8	34	20.0	16.1
50	2111	100.0	0	0.0	0	0.0	0	0.0	0.0
51	724	45.4	2074	20.2	2040	15.8	20	15.5	3.1
52	2823	46.6	3079	28.5	2295	7.7	22	12.6	4.6
53	2511	24.5	2436	12.7	2499	12.6	24	28.1	22.1
54	2621	47.0	2611	41.3	2631	7.9	26	3.1	0.7
55	3264	25.0	3229	18.2	3221	18.0	32	22.2	16.5
56	2911	66.8	3241	15.2	1211	5.1	28	6.0	6.9
57	2911	45.5	3264	13.7	3321	7.1	28	10.6	12.1
58	3312	10.7	3411	4.4	2641	4.2	34	5.2	75.5
59	5171	85.8	3711	2.9	2861	2.0	34	2.4	6.9
60	2911	13.5	2818	10.7	5171	8.0	28	8.9	58.8
61	2891	52.0	2842	37.0	2821	8.5	26	1.1	1.4
62	7212	39.6	7216	31.4	7218	11.1	72	9.6	8.3
63	3861	10.4	9711	6.5	3714	6.3	35	9.0	67.8
64	0	0.0	0	0.0	0	0.0	0	0.0	0.0
65	0	0.0	0	0.0	0	0.0	0	0.0	0.0
66	3711	52.0	3241	48.0	7535	0.1	0	0.0	-0.0
67	3411	99.0	3429	0.9	3211	0.1	0	0.0	0.0
68	3429	96.9	3479	3.1	0	0.0	0	0.0	-0.0
69	2641	80.6	3079	10.0	2649	5.9	26	2.1	1.5
70	2295	82.9	3079	10.7	2261	3.3	22	1.7	1.5
71	2522	5837	2514	36.5	3499	4.8	0	0.0	0.0
72	2511	60.5	2599	24.1	2521	14.6	25	0.8	-0.0
73	3679	24.9	3585	19.9	3411	12.0	34	16.8	26.5
74	3679	96.0	2821	3.9	3861	0.2	0	0.0	-0.0
75	3731	100.0	0	0.0	0	0.0	0	0.0	0.0
76	3728	52.4	3721	47.6	0	0.0	0	0.0	0.0
77	3711	7.8	3411	4.8	0	4.7	34	5.9	76.9
78	0	0.0	0	0.0	0	0.0	0	0.0	0.0
79	2754	59.2	2751	16.3	3079	4.8	26	12.6	7.1
80	2752	75.9	3411	17.2	2751	2.4	27	1.8	2.6
81	2751	61.1	2643	11.3	2649	7.7	26	8.4	11.5
82	2751	41.0	2754	11.8	2653	7.8	26	12.6	26.8
83	3041	95.9	3661	2.3	2641	1.1	37	0.2	0.5
84	4911	89.5	2631	2.2	2421	2.1	49	2.9	3.4
85	2869	22.4	2621	15.1	2421	9.7	29	8.8	43.9
86	2869	46.7	4952	11.0	2642	8.4	65	7.9	26.1
87	4922	37.7	3334	18.8	1311	17.8	49	13.3	12.4
88	4953	23.9	2421	20.5	2499	17.8	28	19.1	18.8
89	2869	44.4	2834	44.4	3634	11.1	0	0.0	-0.0
90	2815	24.6	2899	8.5	2911	6.9	27	8.7	51.3

Three separate VOC Model growth rate files are available based on three national growth rate assumptions (low, moderate and high GNP growth rates). Each file contains over 36,000 specific growth rate factors (101 source categories x 51 regions x 7 time periods). These growth rates can be negative or positive depending on source category/region/time period.

The VOC Model projects future year emissions by applying the appropriate yearly annual growth rate factors to the source category 1980 uncontrolled emission found in the emissions file. Future year increases are considered to be due to new industry capacity. Future year decreases in emissions (negative growth rate) are subtracted from existing and/or future year increases in uncontrolled emissions. If desired, the VOC Model can assign a single annual growth rate as a default value for source categories/regions missing growth rate factors or a single default value can be used instead of the growth rate file.

For states that currently have zero emission for a source category, no future emission will be projected. This occurs because an industry growth rate would be multiplied by zero existing emissions always resulting in zero future year emissions.

SECTION 5

EMISSION CONSTRAINT FILE

The VOC Model projects future year uncontrolled industrial category emissions using the data found in the emissions file and replacement/growth rate files. Future year controlled emission estimates are then calculated based on the data found in the constraint file. Currently, all of the constraints are based on environmental regulations impacting both new and existing VOC emissions.

Application of regulatory constraints in projecting future emissions requires three guidelines: time frame, penetration factor, and control effectiveness. The time frame indicates the beginning year when the regulation should begin to take effect. Also, a target year was established to represent when the constraint was fully implemented. The penetration factor establishes the fraction of emissions in an industrial category that are affected by the constraint. This value is used to account for regulations that cover only a portion of the sources in an industrial category. Also, an accounting of emissions for sources exempt from the constraint are represented by this factor. Control effectiveness is the degree of control mandated by the regulation.

The information found in the constraint file includes the following data for each constraint:

- Constraint name,
- Regional applicability (state AEROS code),
- Industrial category applicability (1 thru 101),
- Emission segment applicability,
 - new sources
 - existing sources
 - replacement sources
 - attainment area
 - non-attainment area

- Constraint time frame,
 - beginning year
 - target year
- Control applicability
 - control effectiveness
 - control penetration

The following subsections discuss the differing types of constraints contained in the file.

RACT

States with ozone non-attainment areas must develop VOC regulations reflecting reasonably available control technology (RACT) for existing sources covered by control techniques guideline (CTG) documents issued by EPA. Table C-1, Appendix C, lists the 500 counties designated as ozone non-attainment areas by EPA in 1979. States must submit the RACT regulations for EPA approval by January 1st of each year for those CTG's that were published before January 1st of the preceding year. Presented in Table 5-1 is a cumulative list of 27 CTG documents issued or under development for industrial sources.^{7,8,9} Eighteen documents covering 25 VOC source categories were published prior to 1980. Seven more documents have been or are planned for issue by the end of 1984. In addition, two other documents are under development for issue in 1986. The CTG recommended emission limits and control technology information for each industrial category are discussed in Table C-2.

In response to the CTG information, states developed RACT regulations for existing source.^{10,11} However, the geographic coverage of the RACT requirements does not correspond exactly with EPA's ozone nonattainment area designations. Some states apply RACT statewide even though some attainment areas exist. Other states have exempted some counties from RACT requirements. Sixteen states and Washington, D.C. have uniform statewide geographic coverage of RACT regulations. Nine states have no RACT regulations by approval of EPA. The remaining states have non-uniform

TABLE 5-1. CTG DOCUMENTS FOR INDUSTRIAL VOC SOURCE CATEGORIES

Source	Document Date*
1. Surface coating	1976
2. Surface coating of cans, coils, paper, fabrics, automobiles, and light-duty trucks	1977
3. Surface coating of metal furniture	1977
4. Surface coating for instulation of magnet wire	1977
5. Surface coating of large appliances	1977
6. Bulk gasoline plants	1977
7. Petroleum storage - Fixed roof tanks	1977
8. Tank truck gasoline loading terminals	1977
9. Solvent metal cleaning - degreasers	1977 ^a
10. Refinery vacuum systems, wastewater separators, and process unit turnarounds	1978
11. Petroleum storage - external floating roof tanks	1978
12. Surface coating of miscellaneous metal parts and products	1978
13. Leaks from petroleum refinery equipment	1978
14. Surface coating of flat wood paneling	1978
15. Manufacture of vegetable oils	1978
16. Pneumatic rubber tire manufacture	1978
17. Synthesized pharmaceutical products	1978
18. Rotogravure and flexography printing	1978
19. Petroleum solvent dry cleaning	1982

(continued)

TABLE 5-1. (Continued)

Source	Document Date [*]
20. Polymers and resins: poly-ethylene, propylene, and styrene	1983
21. Leaks from natural gas/gasoline processing plants	1983
22. VOL storage - SOCFI & Refineries	1984 ^{b,c}
23. Leaks from SOCFI & Polymer Manuf. equipment	1984 ^c
24. Styrene/butadiene copolymers (1981 Draft)	(1984)
25. SOCFI - air oxidation processes (1984 Draft)	(1984) ^c
26. Lithographic printing (1981 Draft)	(1986)
27. Fabric Printing (Dyeing)	(1986)

^aAdditional recommended standards scheduled under CAA Section 111(d).

^bVOL - volatile organic

^cSOCFI - synthetic organic chemical manufacturing industry.

*Scheduled dates for final documents are in parentheses.

geographic RACT coverage by affecting only one or a limited number of counties. In some cases, applicability is specific to a certain city (e.g., City of Baltimore, Maryland). For most states, the primary ozone attainment date was 1982. However, attainment in the more industrialized areas of some states has been delayed until 1987 (e.g., Illinois). Also, some states allow RACT exemptions to small sources in compliance with EPA's "Five Percent Equivalency Rule".¹² Twelve states have adopted uniform exemption "cut-offs" for all VOC source categories; six states exempt only some specific CTG sources. State RACT regulations with the names of affected counties and source exemptions are listed in Tables C-3 and C-4.

RACT constraint forms have been included for all 27 existing/planned CTG's listed on Table 5-1, Tables C-3 and C-4 present the data used to create the constraint file. Wherever possible, the data within a source category were aggregated for entry into the file. The criteria used for aggregation were:

- Target years between 1980 and 1985, or target year of 1987 or later; and,
- Comparable emission limits.

Because of the state exemptions, the penetration factor for RACT regulations is comprised of two terms. One term accounts for the fraction of emissions in the industrial category covered by the regulation. The other term accounts for the fraction of covered emissions affected (not exempted) by state policy. Although some state non-attainment areas have SIP regulations more stringent than RACT for existing sources, the current constraint file does not contain constraint forms reflecting these more stringent regulations.

BACT

EPA new source performance standards (NSPS) and PSD regulations require that major new emission sources use best available control technology (BACT). Table 5-2 shows the current and future NSPS regulations affecting

TABLE 5-2. NSPS PROPOSALS AFFECTING INDUSTRIAL SOURCE VOC EMISSIONS

Source	Initial	Revision
1. Storage vessels for petroleum liquids	June 73	May 78
2. Auto and light duty truck coating: metal components	Oct. 79	July 82
3. Organic solvent cleaners: metal parts	June 80 ^a	-
4. Publication rotogravure printing	Oct. 80	-
5. Beverage can coating	Nov. 80	-
6. Asphalt Blowing stills, storage, roofing, & processing	Nov. 80 ^b	-
7. Metal furniture coating	Nov. 80	-
8. Bulk gasoline terminals	Dec. 80	-
9. Large appliance coating	Dec. 80	-
10. Pressure sensitive tapes and labels	Dec. 80	-
11. Metal coil coating	Jan. 81	-
12. SOCMI-fugitives	Jan. 81 ^c	-
13. Synthetic fibers production: solvent-spin	Nov. 82	-
14. Petroleum solvent dry cleaning	Dec. 82	-
15. Refinery-fugitives	Jan. 83	-
16. Vinyl/urethane film coating and printing	Jan. 83	-
17. Rubber tire manufacturing	Jan. 83	-
18. SOCMI - air oxidation processes	Oct. 83 ^c	-
19. Distillation operations - SOCMI & Refineries	Dec. 83 ^c	-
20. On-shore processing of Natural Gas	Jan. 84	-

(continued)

TABLE 5-2. (Continued)

Source	Initial	Revision
21. SOCFI - polymer and resin manufacturing ^c		-
22. VOL storage - SOCFI & Refineries	Jul. 84 ^{c,d}	-
23. SOCFI - reactor processes ^c		-
24. Magnetic tape coating	Jan. 86	-
25. Refinery - wastewater	May 87	-
26. Plastic parts coating - business machines	Jan. 86	-

^aEffective date deferred until 1985 promulgation for analysis of public comments.

^bParticulate (PM) standard only, but most VOC emissions reduced with PM controls.

^cSOCFI - synthetic organic chemical manufacturing industry.

^dVOL - volatile organic liquid

VOC emitters.¹³ Table D-1, Appendix D, summarizes the data input to the BACT constraint forms. These constraints are applicable to all regions.

PSD regulations require that best available control technology economically achievable be applied to major new source emitters. Table C-5, Appendix C, lists the BACT determination as of April 1984 for major facilities in attainment areas. However, because these determinations are made on a case by case basis, constraint forms were not developed based on these specific determinations.

LAER

New VOC sources in nonattainment areas can be subject to EPA's "Bubble Policy" or the "Dual Source Policy". For the "Dual Source Policy", lowest achievable emission rate (LAER) control technology must be applied before any increase in emissions are offset. EPA has published LAER guidance for twelve VOC source categories.^{14,15} EPA also publishes a clearinghouse document of LAER determinations (periodically updated) to help states develop their LAER levels.¹⁶ LAER determinations are presented in Table C-6, Appendix C.

LAER constraints have been entered into the constraint file as offset constraints. All area sources are exempted. Other categories with no specified LAER constraints were assigned a default value of 90 percent control. All states were given a 20 percent offset level and offset year of 1980. This means that all new emissions in non-attainment areas must meet any applicable LAER constraint and must obtain an emission reduction equal to 120 percent of their controlled emissions.

NESHAP

Presented in Table 5-3 is a cumulative list summarizing the status of eight VOC NESHAP regulations. The final regulation date is included since "existing sources" are not affected until after promulgation. The first NESHAP was proposed in 1976 covering the manufacture of vinyl chloride. The

TABLE 5-3. NESHAP AFFECTING VOC EMISSIONS

Source	Target Species	Initial ^a		Revision ^a	
		P	F	P	F
1. Vinyl Chloride Processes: - Ethylene dichloride process - Oxychlorination process - Vinyl & PVC processes: - Reactors - Latex & misc. products - Dispersion products	Vinyl Chloride	Oct. 76	June 77	Mar. 84	(Apr. 85)
2. Maleic Acid/Anhydride Process	Benzene	Apr. 80	c Jun 84	-	-
3. Ethylbenzene/Styrene Process	Benzene	Dec. 80	c Jun 84	-	-
4. Benzene Storage (not Coke Oven Plants)	Benzene	Dec. 80	c Jun 84	-	-
5. Benzene Fugitives: ^b - Refineries - SOCMI	Benzene	Jan. 81	Jun. 84	-	-
6. Benzene from Coke Ovens/By-Product Recovery Processes: - Process & Storage - Fugitives	Benzene	Aug. 84	-	-	-
7. Coke Oven Emissions: - Door leaks - Direct oven emissions	Hazardous VOC	Sep. 84	-	-	-
8. Acrylonitrile Production	Acrylonitrile	d	-	-	-

^aP = proposal date; F = promulgation date of final regulation; scheduled dates are in parentheses.

^bSOcMI - synthetic organic chemical manufacturing industry.

^cProposal to be resinded by revision date.

^dEPA deleted development in May 1984 - suggested state regulation.

regulation is under review and may be revised by the end of 1984. Three more NESHAP's were initially proposed by the end of 1980. However, EPA withdrew in June of 1984 the proposals for:

- Maleic Anhydride plants,
- Ethylbenzene/Styrene plants, and
- Benzene storage tanks (not coke oven plants).

Two more regulations were proposed by the end of 1984. A seventh NESHAP is under development for later proposal.¹⁷ In May 1984, EPA deleted development of a regulation for acrylonitrile emissions. However, EPA suggested state regulation since only a small number of sources exist (25 plants) and state regulation development is less costly for the country. Detailed information regarding NESHAP regulation constraint forms is presented in Table D-2, Appendix D. NESHAP constraint forms have been developed for:

- Benzene Fugitives from Petroleum Refineries and SOCMIs;
- Vinyl Chloride from Vinyl Chloride Processes; and
- Hazardous VOC from Coke Ovens.

SECTION 6

METHODOLOGY FOR PROJECTING VOC CONTROL COSTS

This section presents the approach used to project estimates of future control costs for VOC emissions from utility and industrial sources. The projections are structured to estimate state level costs of VOC control on a constant year dollar basis (i.e., without inflation). Projection of future year VOC control costs for a state can be defined by a summation of the costs for each industrial category. The annualized cost of VOC control for a source category is the sum of the control costs for all sources which includes existing, new, and replacement capacity. For each industrial category, the projection year control costs are estimated by multiplying the quantity of VOC emission reduction times a control cost effectiveness value.

Cost effectiveness is the ratio of annualized control costs to the quantity of reduced emissions. Cost effectiveness values are affected by many factors, such as control technique and control level. Also, economies of scale (physical size of process), new versus retrofit installations and emission characteristics of the source impact cost effectiveness values.

A range of cost effectiveness values resulting from regulatory constraints are presented in Appendices C and D by industrial category. The tabulated values have all been normalized to the base year 1980. These cost effectiveness values apply only for the corresponding control level, source types (i.e., new vs. existing retrofit) and control technique.

The VOC Model has a cost file which allows the user to input up to twelve control effectiveness/cost data sets. The program uses a stop function extrapolation technique between cost points. For example, assume that two control effectiveness/cost data sets have been input: 50 percent control-\$100/ton and 75 percent control-\$1,000/ton. Thus, for the control effectiveness range of 1 through 50 percent, the control cost would be \$100/ton. For the control effectiveness range of 51 to 75 percent, the cost of control would be \$1,000. And for the control effectiveness range of 76 to 100 percent the cost of control would also be \$1,000/ton. If the user

inputs one cost of control value (cost per ton of VOC controlled), this value will be used for all control effectiveness points for that source category.

The VOC model cost file has been supplied with cost effectiveness values (1980 dollars) as a function of control efficiency for each industrial category. The methodology used in developing cost curves is described in "Control Costs for the Volatile Organic Compound Model" [Radian Corporation, Research Triangle Park, North Carolina; NAPAP Draft Report; October, 1987]. A summary table of VOC control costs is given in Appendix E. Cost file values were derived by averaging new and retrofit costs from Table E-1 and converting to \$/ton.

These values will estimate the average cost of control for a source category. As such, they can provide guidance on which categories may be most cost-effective to regulate when further VOC emission reductions are needed. However, the specific regulation that should apply to a particular category requires a more detailed analysis of the performance and cost of control systems to determine their cost effectiveness for specific process equipment items. More detailed analysis is required since the cost-effectiveness of control for a specific item of process equipment can vary widely from a category- wide average cost-effectiveness value. Specific equipment cost- effectiveness is often affected by its size, annual operating rate and remaining lifetime.

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- U.S. Environmental Protection Agency. 1980. Benzene Emissions from Maleic Anhydride Industry - Background Information for Proposed Standards. EPA-450/3-80-001a (NTIS PB80-152812), Research Triangle Park, N.C. 200p.
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*Federal register citation for proposed regulation included in parentheses.

APPENDIX A

VOC SOURCE CATEGORIES

Presented in Table A-1 is the list of VOC point and area source categories used in projecting emissions from the 1980 NAPAP inventory data base. A total of 90 point source categories and 11 area source categories were selected to aggregate the wide variety of source types. Since the NAPAP emission inventory identifies sources by the EPA 8-digit Source Classification Codes (SCC), these codes are listed for each point source category. The SCC's read across the page by lines. The dashes (-) represent a series of numbers with the same initial digits. AEROS Manual Codes are listed for each area source category since EPA has assigned no SCC's for these sources.

TABLE A-1. VOC UTILITY - INDUSTRIAL SECTOR SOURCE CATEGORIES BY EPA CODES

Point Source Category	Source Classification Codes (SCC)				
1. ON-SHORE CRUDE OIL PRODUCTION	310001--	310888--			
2. ON-SHORE NATURAL GAS PRODUCTION	310002--				
3. PETROLEUM LIQUID LIG. STORAGE ≥ 1.5 PSIA: FLOATING ROOF - STANDING LOSS - CRUDE OIL - BENZENE - GASOLINE - CYCLOHEXANE - Jet Fuel - CYCLOPENTANE - MISC. OTHER - NAPHTHA - ISOPENTANE PRODUCTS	40300201 40300212 40301101 40301141 40400110 40400111	40300203 40300214 40301106 40301143 40400115	40300205 40300215 40301109 40301151 40400207	40300208 40301112 40301153 40400209	40300210 40301131 THRU 40301133 40400303 THRU 40400305
4. PETROLEUM LIQUID STORAGE ≥ 1.5 PSIA: FLOATING ROOF AND V.V.S. - WITHDRAWAL LOSS - SAME LIQUIDS AS #3	40300202 40301107 40400116	40300204 40301108 40400120	40300302 40301117 40400210	40301118 40400213	40301201 THRU 40301204
5. PETROLEUM LIQUID STORAGE ≥ 1.5 PSIA: FIXED ROOFS - SAME LIQUIDS AS #3	40300101 40300115 40300160 40301001 40400301	40300105 40300150 40301015 40400302	40300108 40300153 40400101	40300110 40300155 40400109	40300112 40300157 40400201 THRU 40400206
6. PETROLEUM LIQUID STORAGE ≥ 0.5 PSIA: HEPTANE, ETC.	40300111	40300156	40300211		
7. PETROLEUM LIQUID STORAGE - OTHERS: KEROSENE, DIST. FUEL, ISO-OCTANE, TOLUENE, ETC.	40300106 40300158 40300207 40301113 40301135 40301155 4038----	40300107 40300161 40300213 40301116 40301140 40301197 4039----	40300113 40300198 40300216 40301119 40301144 40301199	40300116 40300199 40300299 40301120 40301145 40301205	40300151 40301016 THRU 40301130 40301150 40301206 40301299
8. PET. REFINERIES - FUGITIVES: BENZENE & OTHER VOC	30600801	THRU	30600820		
9. PET. REFINERIES - PROCESS DRAINS/WASTEWATER	306005--		30600821		
10. PET. REFINERIES - DISTILLATION OPERATIONS	306006--				
11. PET. REFINERIES - PROCESS UNIT BLOWDOWN	306004--				
12. PET. REFINERIES - ASPHALT PROCESSING: BLOWING, ROOFING, CONCRETE	305001--		305002--		
13. PET. REFINERIES - LUBE OIL MANUFACTURER	3061----				
14. PET. REFINERIES - OTHERS: PROCESS HEATERS, SLUDGE CONVERTERS, FLUID COKING, COOLING TOWERS, FLARES, CAT. CRACKING UNITS, PET. COKE CALCINERS, BAUXITE BURNING, & MISC.	306001-- 306012--	THRU THRU	306003-- 306015--	30600822	306009-- 306010--

TABLE A-1. (Continued)

Point Source Category	Source Classification Codes (SCC)									
15. PET. MARKETING - SHIP/BARGE/TANKER VESSELS	406002--	4068----								
16. GASOLINE BULK TERMINALS - TANK TRUCK TRANSFER	40400151 40600141	THRU 40600144	40600101 40600147	40600126 40600162	40600131 40600163	40600136				
17. PET. BULK TERMINALS - OTHERS TRANSFER	40600130 40600143 40600198	THRU 40600132 40600145 40600199	40600135 40600146	40600137 40600148	THRU THRU	40600140 40600161	40600142 40600197			
18. PETROLEUM BULK PLANTS - TANK TRUCK TRANSFER	40400250	THRU	40400254							
19. SOCM1 - VOL STORAGE	30100102 30183001		30101840	30101893	30101894	30101427	30102612			
20. SOCM1 - FUGITIVES: BENZENE & OTHER VOC	30180001		30188---							
21. SOCM1 - ETHYLENE PRODUCTION	30119701									
22. SOCM1 - ACRYLONITRILE PRODUCTION	30125405									
23. SOCM1 - VINYL CHLORIDE/EDC/PVC PRODUCTION	30101801		30112501	30112502	30112540					
24. SOCM1 - MALEIC ACID/ANHYDRIDE PRODUCTION	301100--									
25. SOCM1 - ETHYL BENZENE/STYRENE PRODUCTION	301169--		301206--							
26. SOCM1 - AIR OXIDATION REACTION PROCESSES	30101901 301158--		30101905 301174--	30103102 301202--	301091-- 301205--	301120-- 30125401	301132-- 301810--			
27. SOCM1 - POLYMERS & CO-POLYMERS: PES,PE,PP,PS	30101802 30101839		30101803	30101807	THRU	30101837	30101838			
28. SOCM1 - POLYMERS & CO-POLYMERS: OTHERS	30101805		30101822	THRU	30101842	THRU	30101852			
29. SOCM1 - OTHER REACTOR PROCESSES	30100101 301034-- 30112701 301195-- 30125410		30100103 30112199 301133-- 30119705 30125415	30100104 30112510 THRU THRU	30101891 30112535 301167-- 301258--	30101902 30112599 301176-- 301250--	30101906 30112669 301181-- THRU 301253--			
30. SOCM1 - DISTILLATION OPERATIONS	30100105		30101892	30101904	30101907	30103103	30103104			
31. SOCM1 - CARBON BLACK PRODUCTION	301005--									
32. SOCM1 - TRANSFER/MARKETING: TRUCK & RAIL CARS	30100106		30103105	490003--	THRU	490999--				
33. SOCM1 - OTHER: CHARCOAL, WASTEWATER, MISC.	30100199 301820--		301006-- 3019----	30101890	30101899	30103101	30103199			
34. PHARMACEUTICAL SYNTHESIS	301060--									

TABLE A-1. (Continued)

Category	Source Classification Codes (SCC)									
	30102401	THRU	30102426	30102499	301011--	THRU	301013--	301023--		
35. SYNTHETIC FIBER MANUFACTURE - SOLVENT SPIN	301025--									
36. SYNTHETIC FIBER MANUFACTURE - OTHERS	301003--		301007--		301008--					
37. INORGANIC CHEMICAL MANUFACTURE	301032--		301130--							
38. FERMENTATION PROCESSES: ALCOHOL PRODUCTS	302009--		302010--		302011--					
39. VEGETABLE OIL PROCESSING	302019--									
40. PLASTIC PRODUCTS MANUFACTURE	308007--		3089----							
41. RUBBER TYRE MANUFACTURE	308001--	THRU	308005--							
42. SYNTHETIC RUBBER MANUFACTURE	30102601	THRU	30102611		30102613	THRU	30102699	308006--		
43. OTHER CHEMICAL: SOAPS/DET., EXPLOSIVES, COATINGS, AGR.	301009--		301010--		301014--		301015--	301020--		301033--
	301040--	THRU	301045--		301111--					
44. IRON & STEEL MANUFACTURE - COKE OVENS	30300301	THRU	30300314		30300316	THRU	30300399	303004--		
45. IRON & STEEL MANUFACTURE - COKE OVEN BY-PRODUCT RECOVERY	30300315									
46. IRON & STEEL MANUFACTURE - OTHERS	303008--		303009--							
47. PRIMARY/SECONDARY METALS & ELECTRICAL	303001--		303002--		303005--	THRU	303007--	303010--		303030--
	3038----		3039----		304001--	THRU	304020--	304040--		304050--
	3048----		3049----							
48. SECONDARY METALS - HEAT TREATING	304022--									
49. FABRICATED METAL PRODUCTS	309----									
50. TOBACCO PRODUCTS	302033--									
51. FOOD PRODUCTS	302007--		302008--		302012--	THRU	302018--	302032--		3028----
	3029----									
52. TEXTILE MILL & LEATHER PRODUCTS	32-----		33-----		401004--					
53. LUMBER AND WOOD PRODUCTS	307005--	THRU	307008--		307020--		307030--	3078----		3079----
54. PAPER AND ALLIED PRODUCTS	307001--	THRU	307004--		307011--		307013--			
55. MINERAL PRODUCTS - STONE, CLAY, GLASS	305003--	THRU	305009--		305012--	THRU	305014--			
56. IN-PROCESS FUEL USE - COAL	390001--	THRU	390003--							
57. IN-PROCESS FUEL USE - FUEL OIL	390004--	THRU	390005--							
58. IN-PROCESS FUEL USE - PROCESS AND NATURAL GAS	390006--		390007--							

TABLE A-1. (Continued)

Category	Source Classification Codes (SCC)			
59. IM-PROCESS FUEL USE - OTHER: COKE, WOOD, WASTE, ETC.	390008--	THRU	390013--	
60. OTHER INDUSTRIAL PROCESSES: MINING & MISC.	303011--	THRU	303024--	3999----
61. ADHESIVES MANUFACTURE	301050--			
62. DRY CLEANING - PETROLEUM SOLVENT	40100102		40100104	THRU 40100199
63. ORGANIC SOLVENT METAL CLEANING AND DEGREASING	401002--		401003--	
64. INDUSTRIAL SURFACE COATING - LARGE APPLIANCES	402014--			
65. INDUSTRIAL SURFACE COATING - MAGNET WIRE	402015--			
66. INDUSTRIAL SURFACE COATING - AUTO & LT. TRUCK:	402016--			
67. INDUSTRIAL SURFACE COATING - CAMS	402017--			
68. INDUSTRIAL SURFACE COATING - METAL COILS	402018--			
69. INDUSTRIAL SURFACE COATING - PAPER	402013--			
70. INDUSTRIAL SURFACE COATING - FABRIC & FILMS: VINYL, URETHANE, AND OTHERS	402011--			
71. INDUSTRIAL SURFACE COATING - METAL FURNITURE	402020--			
72. INDUSTRIAL SURFACE COATING - FLAT WOOD PRODUCTS	402021--			
73. INDUSTRIAL SURFACE COATING - OTHER METAL/WOOD PRODUCTS	402019--		402025--	
74. INDUSTRIAL SURFACE COATING - PLASTIC PARTS: BUSINESS MACHINES & OTHERS	402022--			
75. INDUSTRIAL SURFACE COATING - LARGE SHIPS	402023--			
76. INDUSTRIAL SURFACE COATING - LARGE AIRCRAFT	402024--			
77. INDUSTRIAL SURFACE COATING - HANDLING COATING/ SOLVENT, FUGITIVES, AND OTHERS	402001--	THRU	402010--	4028---- 4029----
78. GRAPHIC ARTS - ROTODUPLICATION PRINTING	40500513			
79. GRAPHIC ARTS - ROTODUPLICATION PACKAGING PRINTING	40500501		40500511	40500512
80. GRAPHIC ARTS - OFFSET LITHOGRAPHY PRINTING	405004--			
81. GRAPHIC ARTS - FLEXOGRAPHIC PRINTING	40500301		40500311	40500312

TABLE A-1. (Continued)

Category	Source Classification Codes (SCC)									
	405001--	405002	40500302	40500307	40500502	40500510	40500598	405007--	4058----	490001--
82. GRAPHIC ARTS - OTHER: LETTERPRESS, OTHER GRAVURE, ETC.										
83. MISC. SOLVENT USE: DYEING & EXTRACTION & FUGITIVES										
84. UTILITY BOILERS										
85. INDUSTRIAL BOILERS										
86. INDUSTRIAL SPACE HEATERS										
87. STATIONARY INTERNAL COMBUSTION										
88. SOLID WASTE DISPOSAL - INDUSTRIAL										
89. WASTE SOLVENT RECOVERY										
90. NOT CLASSIFIED - MISCELLANEOUS										

AEROS Manual Codes

13
14
15
16
17
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19
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22
25
53

AREA SOURCE CATEGORY

1. Industrial Anthracite Coal
2. Industrial Bituminous Coal
3. Industrial Coke
4. Industrial Distillate Oil
5. Industrial Residual Oil
6. Industrial Natural Gas
7. Industrial Wood
8. Industrial Process Gas
9. Industrial Onsite Incineration
10. Industrial Open Burning
11. Solvent Purchased

APPENDIX B
VOC EMISSIONS DATA BASE

Table B-1 and B-2 presents utility and industrial point and area source VOC emissions for the 48 contiguous U.S. states plus D.C. This summary was developed from Version 3.0 (March 1984) of the NAPAP point source and 1980 NEDS area source inventory (U.S. EPA. 1980. National Emission Report, National Emission Data System. EPA-450/4-82-010 (NTIS PB82-237165), Research Triangle Park, N.C.).

TABLE B-1. 1980 NATIONAL SUMMARY OF NAPAP UTILITY AND INDUSTRIAL
SECTOR VOC EMISSIONS BY STATE, 1,000 TONS/YEAR

State	No. of Points	Point Source ^a	
		Uncontrolled Emissions	Reported Emissions
01 Alabama	903	496	73
03 Arizona	319	13	7
04 Arkansas	151	46	14
05 California	18,691	1,376	398
06 Colorado	834	38	21
07 Connecticut	998	73	44
08 Delaware	224	460	26
09 D.C.	36	1	1
10 Florida	250	23	21
11 Georgia	786	63	28
13 Idaho	235	5	5
14 Illinois	2,564	510	207
15 Indiana	1,999	1,427	116
16 Iowa	629	115	30
17 Kansas	1,506	279	81
18 Kentucky	2,744	277	125
19 Louisiana	2,725	1,704	321
20 Maine	398	24	20
21 Maryland	488	426	76
22 Massachusetts	1,015	110	106
23 Michigan	1,929	614	232
24 Minnesota	1,242	68	63
25 Mississippi	582	159	52
26 Missouri	863	418	176
27 Montana	187	39	12
28 Nebraska	244	57	46
29 Nevada	146	6	4
30 New Hampshire	185	83	20
31 New Jersey	10,174	830	154
32 New Mexico	847	57	52
33 New York	1,910	142	142
34 North Carolina	2,342	1,239	108
35 North Dakota	49	2	2
36 Ohio	3,656	416	164
37 Oklahoma	1,050	1,397	72
38 Oregon	689	156	40
39 Pennsylvania	4,451	619	239
41 Rhode Island	370	24	13

TABLE B-1. (Continued)

State	No. of Points	Point Source ^a	Reported Emissions
		Uncontrolled Emissions	
42 South Carolina	1,167	380	225
43 South Dakota	101	3	3
44 Tennessee	2,691	1,083	156
45 Texas	9,196	12,611	938
46 Utah	249	15	10
47 Vermont	149	4	4
48 Virginia	1,691	617	102
49 Washington	952	281	47
50 West Virginia	325	112	13
51 Wisconsin	1,691	117	75
52 Wyoming	255	22	20
TOTAL:	86,876	29,036	4,903

*48 States plus D.C. from Version 3.0 of the NAPAP point source and 1980 NEDS area source inventories. The following are not listed as part of the NAPAP program:

<u>Code</u>	<u>State/Territory</u>
2	Alaska
12	Hawaii
40	Puerto Rico

^a90 Point Source Categories. See Table A-1

^b11 Area Source Categories.

TABLE B-2. ATTAINMENT AREA EMISSIONS - TONS PER YEAR

State Code	VOC Model Industrial Category										
	91	92	93	94	95	96	97	98	99	100	101
01	0	0	0	0	0	0	0	0	0	0	0
03	0	4	0	3	0	2,406	0	0	244	320	8,473
04	0	7	0	2	0	10,462	0	0	74	25	64,229
05	0	0	0	0	0	0	0	0	0	0	0
06	0	0	0	7	4	2,654	0	0	4	1	16,741
07	0	0	0	0	0	0	0	0	0	0	0
08	0	0	0	0	0	0	0	0	3	0	517
09	0	0	0	0	0	0	0	0	0	0	0
10	0	4	0	0	0	171	0	0	16	6	24,556
11	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	3	0	38	0	0	0	0	12,392
14	0	0	0	0	0	0	0	0	0	0	0
15	0	54	0	5	0	108	0	0	362	444	152,202
16	0	35	0	5	2	3,370	0	0	352	0	68,776
17	0	34	0	28	3	36,490	0	0	39	61	35,310
18	0	1	0	0	0	231	0	0	15	12	3,533
19	0	0	0	0	0	0	0	0	0	0	0
20	0	1	0	0	0	0	0	0	8	17	7,463
21	0	0	0	9	0	1,172	0	0	138	230	64,450
22	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	4,485	0	0	0	0	92,937
25	0	0	0	0	0	23,864	0	0	0	105	57,933
26	0	101	0	0	21	187	1	0	110	81	92,524
27	0	0	0	0	17	1,367	0	0	0	17	5,079
28	0	27	0	0	3	1,208	0	0	0	0	13,924
29	0	1	0	1	0	3	0	0	0	0	1,450

TABLE B-2. ATTAINMENT AREA EMISSIONS - TONS PER YEAR (Continued)

State Code	VOC Mutual Industrial Category										
	91	92	93	94	95	96	97	98	99	100	101
30	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	1	1	0	0	0	23	10	4,603
33	0	0	0	4	0	389	0	0	179	256	126,654
34	0	5	0	0	0	3,374	24	0	636	596	128,112
35	0	14	0	3	0	0	0	0	17	0	4,186
36	0	0	0	0	0	0	0	0	0	0	0
37	0	2	0	7	0	33,922	0	0	0	0	34,992
38	0	0	0	10	0	2,040	78	0	16	61	34,141
39	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0
43	0	1	0	0	0	0	0	0	37	0	6,538
44	0	0	0	0	0	0	0	0	0	0	0
45	0	17	0	62	55	280,370	0	0	352	219	146,774
46	0	3	0	9	6	5,729	0	0	49	0	17,210
47	0	0	0	0	0	0	0	0	5	0	4,094
48	0	24	0	0	0	3,140	0	0	248	32	72,563
49	0	0	0	10	6	1,452	0	0	18	75	30,571
50	0	0	0	15	0	8,413	0	0	0	19	21,768
51	0	0	0	0	0	0	0	0	0	0	0
52	0	4	0	40	2	10,984	0	0	22	0	1,102

TABLE B-2. NONATTAINMENT AREA EMISSIONS - TONS PER YEAR (Continued)

State Code	91	92	93	94	95	96	97	98	99	100	101
	VOC Model Industrial Category										
01	0	22	0	0	0	17,056	0	1	0	208	80,407
03	0	9	0	7	0	4,670	0	0	473	621	16,447
04	0	0	0	0	0	213	0	0	2	1	1,311
05	0	13	0	0	0	22,808	0	0	203	712	426,532
06	0	0	0	8	5	3,115	0	0	5	1	19,652
07	0	0	0	21	7	56	0	0	0	0	100,324
08	0	0	0	0	0	9	0	0	61	0	12,402
09	0	0	0	1	0	0	0	0	0	0	5,182
10	0	16	0	0	0	605	0	0	55	22	87,063
11	0	1	0	0	0	2,135	0	0	1	1,067	121,011
13	0	0	0	0	0	0	0	0	0	0	0
14	0	39	0	0	0	2,256	0	0	0	0	246,769
15	0	7	0	1	0	15	0	0	49	61	20,755
16	0	0	0	0	0	0	0	0	0	0	0
17	0	4	0	3	0	4,510	0	0	5	7	4,364
18	0	15	0	7	0	3,070	0	0	199	153	46,945
19	0	0	0	0	0	11,440	0	0	0	0	39,957
20	0	1	0	0	0	0	0	0	15	31	13,860
21	0	0	0	0	0	12	0	0	1	2	641
22	0	3	1	9	0	93	0	0	100	72	160,850
23	0	0	0	0	0	9,606	0	0	197	133	261,240
24	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0
26	0	41	0	0	9	77	0	0	45	33	37,792
27	0	0	0	0	0	0	0	0	0	0	0
28	0	9	0	0	1	424	0	0	0	0	4,892
29	0	1	0	1	0	3	0	0	0	0	1,445

TABLE B-2. NONATTAINMENT AREA EMISSIONS - TONS PER YEAR (Continued)

State Code	VOC Model Industrial Category										
	91	92	93	94	95	96	97	98	99	100	101
30	0	0	0	1	0	1	0	0	16	0	27,436
31	0	0	0	33	0	52	0	0	278	0	200,270
32	0	0	0	1	0	0	0	0	19	9	3,921
33	0	0	0	8	0	692	0	0	319	454	225,162
34	0	0	0	0	0	178	1	0	33	31	6,743
35	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	25	0	17,754	0	0	949	1,246	334,152
37	0	0	0	2	0	7,957	0	0	0	0	8,288
38	0	0	0	2	0	510	19	0	4	15	8,537
39	0	0	0	23	0	11,511	0	0	237	0	295,168
41	0	0	0	3	0	24	0	0	5	59	37,388
42	0	5	0	0	0	2,277	0	0	0	122	70,020
43	0	0	0	0	0	0	0	0	0	0	0
44	0	12	0	0	0	2,039	0	0	0	74	87,525
45	0	9	0	32	29	144,434	0	0	181	113	75,611
46	0	0	0	0	0	117	0	0	1	0	351
47	0	0	0	0	0	0	0	0	5	0	4,094
48	0	3	0	0	0	349	0	0	27	4	8,063
49	0	0	0	8	5	1,096	0	0	14	56	23,063
50	0	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	1,893	0	0	151	240	115,263
52	0	0	0	0	0	0	0	0	0	0	0

APPENDIX C
STATE REGULATIONS AND RELATED POLICIES

This appendix presents information about State VOC regulations and policies. The following information is presented in two groups that affect VOC sources in ozone attainment and nonattainment areas of a State:

Nonattainment Areas

- Control Techniques Guidelines (CTG),
- Geographic coverage of RACT regulations,
- RACT regulations,
- RACT exemptions,
- LAER guidelines and determinations, and
- State general VOC regulations.

Attainment Areas

- PSD major source categories, and
- BACT determinations.

GEOGRAPHIC COVERAGE OF RACT

Presented in Table C-1 is a list of the geographic county/county equivalents affected by RACT regulations in each State. The Aerometric and Emissions Reporting System (AEROS) manual code for each State is shown. The code numbers for the State geographic areas can be found in the AEROS manual also.¹ Nine States have no RACT regulations (denoted by NRR). The States of Hawaii and Alaska and the territory of Puerto Rico are not listed as part of the NAPAP.

TABLE C-1. GEOGRAPHIC COVERAGE OF STATE VOC RACT REGULATIONS*

AEROS Manual Code	State	Attainment Year	County/County Equivalents
01	Alabama	82	Statewide
03	Arizona	82	Maricopa
04	Arkansas	82	Pulaski
05	California	87	Statewide
06	Colorado	87	Adams, Arapahoe, Boulder, Denver, Douglas, & Jefferson
07	Connecticut	87	Statewide
08	Delaware	87	New Castle
09	D.C.	87	All
10	Florida	82	Broward, Dade, Duval, Hillsborough, Orange, Palm Beach, & Pinellas
11	Georgia	82	Statewide
13	Idaho	-	NRR
14	Illinois	82	Statewide, <u>except</u> 9 exempt until 1987
		87	Add 9: Cook, DuPage, Kane, Lake, McHenry, Will, Madison, Monroe, & St. Claire
15	Indiana	82	Marion
		87	Add: Allen, Clark, Floyd, Lake, & Porter
16	Iowa	-	NRR
17	Kansas	82	Douglas, Johnson, & Wyandotte

(continued)

TABLE C-1. (Continued)

AEROS Manual Code	State	Attainment Year	County/County Equivalents
18	Kentucky	82	Statewide, <u>except</u> for Garrard, Graves, Hopkins, Laurel, Montgomery, Nelson, Pulaski, Scott, Taylor, Trigg, & Union and 4 <u>exempt</u> until 1987
		87	Add 4: Boone, Campbell, Kenton, & Jefferson
19	Louisiana	82	Statewide
20	Maine	82	Statewide, <u>except</u> Aroostook, Hancock, Penobscot, Piscataquis, & Washington
21	Maryland	82	Washington
		87	Add: Anne Arundel, Baltimore, Carroll, Harford, Howard, Montgomery, Prince Georges, & City of Baltimore
22	Massachusetts	87	Statewide
23	Michigan	82	Statewide, <u>except</u> 7 exempt until 1987
		87	Add: Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, & Wayne
24	Minnesota	-	NRR
25	Mississippi	-	NRR
26	Missouri	82	Clay, Platte, & Jackson
		87	Add: Franklin, St. Charles, St. Louis, & Jefferson
27	Montana	-	NRR

(continued)

TABLE C-1. (Continued)

AEROS Manual Code	State	Attainment Year	County/County Equivalents
28	Nebraska	82	Douglas & Sarpy
29	Nevada	82	Clark, Douglas, Washoe, & Carson City
30	New Hampshire	82	Statewide
31	New Jersey	87	Statewide
32	New Mexico	82	Bernalillo
33	New York	82	Albany, Cayuga, Columbia, Dutchess, Erie, Genessee, Greene, Livingston, Monroe, Niagara, Onondaga, Ontario, Orlange, Orleans, Putnam, Rensselaer, Saratoga, Schenectady, Seneca, Ulster, Wayne, Wyoming, & Yates
		87	Add: Nassau, Suffolk, Rockland, Westchester, & New York City
34	North Carolina	82	Mecklenburg
35	North Dakota	-	NRR
36	Ohio	87	Statewide
37	Oklahoma	82	Oklahoma & Tulsa
38	Oregon	82	Jackson & Lane
		87	Add: Clackamas, Marion, Multnomah, & Washington
39	Pennsylvania	82	Statewide, <u>except</u> 13 exempt until 1987
		87	Add: Allegheny, Armstrong, Beaver, Butler, Bucks, Chester, Delaware, Lehigh, Northampton, Philadelphia, Montgomery, Washington, & Westmoreland

(continued)

TABLE C-1. (Continued)

AEROS Manual Code	State	Attainment Year	County/County Equivalents
41	Rhode Island	87	Statewide
42	South Carolina	82	Statewide
43	South Dakota	-	NRR
44	Tennessee	82	Statewide, <u>except</u> 1 exempt until 1987
		87	Add: Nashville - Davidson
45	Texas	82	Bexar, Brazoria, Dallas, El Paso, Galveston, Gregg, Jefferson, Nueces, Orange, Tarrant & Victoria
		87	Add: Harris
46	Utah	82	Utah & Weber
		85	Add: Davis & Salt Lake
47	Vermont	82	Chittendon, Addison & Windsor
48	Virginia	82	Arlington, Prince, William, Hampton, Newport News & Norfolk
		87	Add: Chesterfield, Henrico, Fairfax, Loudoun & Stafford
49	Washington	87	Clark, King, Pierce, & Snohomish
50	West Virginia	-	NRR
51	Wisconsin	82	Statewide, <u>except</u> 9 exempt until 1987
		87	Add: Douglas, Grant, Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington & Waukesha

(continued)

TABLE C-1. (Continued)

AEROS Manual Code	State	Attainment Year	County/County Equivalents
52	Wyoming	-	NRR

*The following are not listed as part of the NAPAP program:

<u>Code</u>	<u>State/Territory</u>
2	Alaska
12	Hawaii
40	Puerto Rico

NRR - No RACT Regulations.

The table shows the year that each State has mandated full attainment of RACT requirements. These attainment dates range from 1982 to 1987. Eleven States and D.C. have uniform statewide coverage; other States require RACT for only one county. In some States, RACT-affected counties have different attainment dates.

CTG

Presented in Table C-2 is a list of EPA's VOC CTG recommendations to the States. These recommendations are presented in order of the affected source category, as listed in Table A-1 (Appendix A). The table shows the affected facilities within the source category and the publication date of the background document (in parentheses), the recommended VOC emission limit standard, the control techniques expected to be used, the retrofit control cost effectiveness (\$/ton VOC reduced) to meet the standard-normalized to a 1980 basis, and any comments from the background document or the Environment Reporter (current developments). New CTG's are also announced in the new EPA VOC RACT Clearinghouse Newsletter published by the U.S. EPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

An attempt was made to present the emission limit data on a common basis. Where possible, the various forms of standards emission limits were converted to a percentage limit. The conversions are based on assumed typical operating characteristics as described in the reference documents.

The control cost information applies to retrofit of existing sources, not new source construction. The cost data are presented in the form of ranges. The ranges result from variations in applied control techniques, process characteristics, and economies of scale (i.e., control cost effectiveness is lower for larger sources). The cost values have been normalized to a base year by ratioing the Chemical Engineering cost indices for the year 1980 and the reference year of the model plant cost analysis. Cost values in parentheses represent cost savings from recovery techniques.

TABLE C-2. CTG BY SOURCE CATEGORY

Source Category	Affected Sources ^a (Pub. Year)	Recommended VOC Emission Limit ^b	Control Technique ^c	1980 Retrofit Control Cost Effectiveness ^d Range, \$/ton Reduced		Comments
2 - Fugitive Emissions From - Natural Gas Processing - Gasoline Processing	(1984)	10,000 ppm (29%)	LDAR Quarterly Insp.	100 to 2,000		- State RACT due for EPA approval by Jan. '86 - 50% of leaks from valves - VOC are 39% of total H.C. emissions - 71% emission reduction average - Exemptions to fluids with less than 1.0 wt.% VOC and heavy liquids and vacuum service and small gas plants, < 10 MM CFD - Equipment handling fluids consisting of less than 1.0 wt.% VOC are exempt (i.e., product H.G. since mostly CH₄ which is not a VOC).
3 - Petroleum Liquid Storage In External Floating Roof Tanks:	(1978)	(5%)	Retrofit of RIM MTD. Secondary Seal	Gasoline: (50) to 4,100 Crude: 25 to 5,700		- Exemptions to small tanks (<420,000 gals) prior to lease custody transfer - 1978 ext. F.R. emissions at 65,000 Mg - EXT. F.R. tanks are 90% floating roof designs - 95% overall control expected
3 & 5 - VOL Storage: Petroleum Liquids - ≥ 1.5 PSIA ≥ 40,000 Gals.	(1984)	(5%)	Upgrade F.R. Install Floating Roof OR.	Upgrade FR: 0 to 2,000 FXD Roof: 2,200 to 2,500		- State RACT due for EPA approval by Jan. '86 - 95% overall reduction expected by installing gaskets & better seals on floating roofs & controls on fixed roofs - Exemptions to crude oil & condensate storage prior to custody transfer
5 - Fixed Roof Petroleum Storage - Capacity > 40,000 gals - Vapor Pressure > 1.5 PSIA	(1977)	(10%)	Retrofit Internal Floating Roofs or Equiv. Control	Gasoline: (100) to 100 Crude: (100) to 300		- Exemptions to: crude oil & condensate prior to lease custody transfer in tanks < 420,000 gals. - 1976 Storage Emissions FXD - 557,000 MG/YR F.R. - 134,000 MG/YR
8 - Petroleum Refineries - Equipment Leaks	(1978)	10,000 ppm (31%)	LDAR - Quarterly Insp. - Gas - Annual Insp. - LL	Cost Equals Credit		- About 56% of refineries located in ozone M-A areas - 69% reduction expected on affected sources yields about 39% industrywide reduction

(continued)

TABLE C-2. (Continued)

Source Category	Affected Sources ^a (Pub. Year)	Recommended VOC Emission Limit ^b	Control Technique ^c	1980		Comments
				Retrofit Control Cost Effectiveness Range, \$/Ton Reduced ^d		
20 - Fugitive Emissions From SOCMH and Polymer Manufacturer of PE, PP, & PS	(1984)	- 10,000 ppm 37%	- LDAR - Quarterly Insp.	12 to 340		- Styrene-butadiene and other polymers/resins are exempt. - 1980 nationwide fugitive emissions would be reduced about 67% from 169,000 to 119,000 mg - 52% of plants - high cost effectiveness - 15% - low cost effectiveness - Possible exemption of small sources processing < 4,000 Mg/Yr light liquid or gaseous VOC - Equipment handling fluids consisting of less than 10.0 Mt. % VOC are exempt - State RACT due to EPA by January 1986
26 - SOCMH - Air Oxidation Process	(1984)	(20%)	TH, OX			- State RACT due to EPA by January 1986 - 1980 nationwide emissions at 50,200 MG - 49 sources of 164, in MA area - In 1986, 75% reduction from uncontrolled at 78,000 MG to 22,000 MG
27 - Manufacturing of High Density Resins: - Polyethylene - Polypropylene - Polystyrene	(1983)	20 ppm Allowed (2%)	- Vent Off Gas to 90% Incinerator	- 35 - 20 - 290		- State RACT due to EPA by January 1985 - 36% of polymers & resins - 90% of reduction required - PE, PP, & PS are about 75% of source category
34 - Synthesized Pharmaceutical Products - Process Vents - Storage, > 4.0 PSIA	(1978)	(10%)	- Surface Condensers - Liquid Transfer Vapor Balance Systems - Wet Scrubbers - Carbon Adsorbers - LDAR - Covers on Containers			- 90% overall control
39 - Vegetable Oil Manufacture - Extractor/Chilled Water Condenser Vents - Post Desolventizer Vents	(1978)	- 5% - About 50% (37%)	- 95% Scrubber - Work Practice			- 50% of emissions from condenser vent - 32% from desolventizer equipment yields 63% overall control

(continued)

TABLE C-2. (Continued)

Source Category	Affected Sources ^a (Pub. Year)	Recommended VOC Emission Limit ^b	Control Technique ^c	1980 Retrofit Control Cost Effectiveness ^d Range, \$/Ton Reduced		Comments
				A	B	
41 - Pneumatic Rubber Tire Manufacture	(1978)	(20%)	- Vapor Capture - Catalytic Oxidation - Water-based Sprays	300 to 1,600	- Overall control efficiency varies from 60 to 80%. Most sources in urban areas. 1977 emissions at 70,000 Mg would reduce about 80% to 14,000 Mg by retrofit	
62 - Petroleum Solvent Dry Cleaners	(1982)	kg/100 kg DA B.5 - (28%) B.5 - (37%) 7.5 - (34%)	- Recovery Dryers - Cartridge Filters - Improved Work Practice	(530) (430) (370)	- Most plants in rural areas - 1980 nationwide emissions would be reduced about 66% from 26,700 Mg to 9,000 Mg - 50% of filter plants use cartridges - 230 plants: 30(D), 30(C), 170(S) ₃ - Exemption to small plants (<123 m ³ solvent/yr)	
63 - Solvent Metal Cleaning	(1977)	A - 50% - 55% - 75% (55%)	A - Covers, - A+C.A. Drains, or F.B. M.P. - A+C.A. or F.B. - Covers, - A+C.A. or M.P. - Chiller - M.P.	B - 35% 40% 40% (37%) (200) to 25 (100) to 1,000 (200) to (100)	- Two recommended control levels - Small open top vapor (<1m ²) & (<2m ²) conveyORIZED degreasers exempt from using control devices - 1974: 705,000 Mg emissions (726,000 UMC) in mostly urban areas - In 1974 uncontrolled emissions split: 55% by cold cleaners, 30% by vapor degreasers, 15% by conveyors, (A) 45% overall control, (B) 63% overall control	
64 - Industrial Surface Coating - Larger Appliances - Washers, Dryers, Ranges - AC & Others	(1977)	LB/Gal. - 2.8 (20%)	- Low VOC Coatings	(1,100) to 700	- Min. of 62% solids coating required from 30% average conventions - 80% emissions reduction avg. - 95% reduction achievable by powder coating	
65 - Industrial Surface Coating - Magnet Wire	(1977)	LB/Gal. - 1.7 (20%)			- Assume 80% overall control since EL is lower than most others	

(continued)

TABLE C-2. (Continued)

Source Category	Affected Sources ^a (Pub. Year)	1980 Recommended VOC Emission Limit ^b		Control Technique ^c	Retrofit Control Cost Effectiveness ^d Range, \$/ton Reduced ^e	Comments
		Lb./Gal.	Kg/L			
66 - Industrial Surface Coating - Auto & Lt. Truck	- Prime Coating - Top Coating - Final Repair Coating	- 1.9	0.23	- Elect. Prime/WB - W.B. or C.A. or OX. - Low VOC Coating	600 to 1,500	- Prime coats std. yields 65 to 90% reduction - In 1976, elect. primers used at half of sites. W.B. not feasible for final repair. 40 to 90% emission reduction achievable depending on VOC content relative to old coating - EPA suggests compliance deferred until 1987 to allow R&D
		- 2.8	0.34			
		- 4.8	0.58			
			50%			
67 - Industrial Surface Coating - Cans	- Sheet coating & 2 P.C. ext - 2/3 PC Int. & End Ext. - 3 PC Side Seam - End Seal	Lb./Gal.	Kg/L	- W.B. - OX.	100 to 800	- 60 to 90% reduction achievable - 80% is cost effective
		- 2.8	0.34			
		- 4.2	0.51			
		- 5.5	0.66			
68 - Industrial Surface Coating - Metal Coils	(1977 & 1981)	- 3.7	0.44	- W.B. - OX.	30 to 70	- 60 to 93% reduction achievable - 64% is cost effective
			(20%)			
		Lb./Gal.	Kg/L			
		- 2.6	0.31			
69 - Industrial Surface Coating - Paper	- Adhesive Tapes & Labels - Gift Wrap & Book Covers - Carbon Paper & Typewriter Ribbons - Photographic Film & Mag. - Tape & Other Plastic Films - Metal Foil W/Paper	- 2.9	0.35	- Low VOC Coating - Carbon adsorber - Oxidation	(40) to 60	- 80 to 99% reduction achievable
			(20%)			
		Lb./Gal.	Kg/L			
		- 2.9	0.35			
70 - Industrial Surface Coating - Fabrics	- Textile Substrates - Vinyl	- 3.8	0.45	- Low VOC Coating - Capture W/Solvent-borne Coating - C.A. - Cat. OX.	(40) to 60	- Most facilities in 1976 were old - some over 40 years - About 80% overall control is cost effective
			(20%)			
		Lb./Gal.	Kg/L			
		- 2.9	0.35			

(continued)

TABLE C-2. (Continued)

Source Category	Affected Sources ^a (Pub. Year)	1980 Recommended VOC Emission Limit ^b		Control Technique ^c	Retrofit Control Cost Effectiveness ^d Range, \$/Ton Reduced	Comments
		Lb/Gal	kg/L			
71 - Industrial Surface Coating - Metal Furniture	(1977)	- 3.0	- 0.36	- Low VOC Coating	(100) to (200)	- Plants located throughout U.S.
			(40%)	- Waterborne Coatings	200 to 500	- About 60% overall control - 96% Achievable at higher cost of double
72 - Industrial Surface Coating - Flatwood Paneling	(1978)	- 1.7 (6.0)	- 0.20 (2.9)	- M.B. Coatings		- Exemption to exterior siding, tile board, or particle board for furniture
		- 3.2 (12.0)	- 0.38 (5.8)	- TH OX.		- M.B. coatings reduced VOC content by 70 to 90% - 1975 uncontrolled emissions estimate 67,000 Mg
73 - Industrial Surface Coating - Misc. Metal Parts & Products	(1978)	- 4.3	- 0.52	- Low VOC Coating	(150) to 1,600	- MB & high solid achieve 50 to 90% reduction
		- 3.5	- 0.42	- M.B.		- MB - EDP & powder can achieve 90% reduction - Metal parts is about 50% of source category
74 - Industrial Surface Coating - Farm Machinery, Small Appliances, Comm. & Office Machinery, Ind. Machinery, Fab. Metal Prod.	(1978)	- 4.3	- 0.52			
		- 3.5	- 0.42			
75 - Industrial Surface Coating - Clear Coating	(1978)	- 3.5	- 0.42			
		- 3.0	- 0.36			
76 - Graphic Arts: Printing - Publication Rotogravure	(1978)	- 25%		- Low VOC Inks	(10) to 60	- 75% overall control
				- Capture Systems	400 to 10,000	- 27 plants in 15 states
79 - Graphic Arts: Packaging Rotogravure	(1978)	- 35%		- 90% Carbon Adsorber	40 to 10,000	- Illinois has 6 pub roto plants
				- 90% OX		- Overall control level - 65% package printing on paper, film, foil, & paperboard - 60% overall control
81 - Graphic Arts: Flexographic	(1978)	- 40%		- Low VOC Inks		
				- Capture Systems		
82 - Graphic Arts: Flexographic	(1978)	- 40%		- 90% Carbon Adsorber		
				- 90% OX		

(continued)

TABLE C-2. (Continued)

FOOTNOTES:

^a Category numbers correspond to point source category list in Table A-1; document publication dates in parentheses; $m = .0038$ gals; $kPa = 0.144$ PSIA.

^b Coating limit minus water; percent emission limit in parentheses are calculated equivalents; DA = Dry Article; A.S. = Applied Solids.

^c W.B. = Waterborne Coatings; CA = Carbon Adsorption; OX = Thermal or Catalytic Oxidation with heat recovery; Cond. = Condensate; F.R. = Floating Roof; V.R. = Vapor Recovery; LDAR = Leak Detection and Repair; TE = Transfer Efficiency.

^d Parentheses = Cost Savings/Recovery; \$/ton x 1.1 = \$1 MG; higher costs for smaller sources; retrofit cost for existing sources relative to uncontrolled sources, range by source size: high costs for small sources; all sources; all costs normalized to year 1980.

RACT REGULATIONS

Presented in Table C-3 is a list of the source categories affected by State RACT regulations. The table shows the affected facilities within each category, the source category coverage fraction of the regulation, the AEROS manual codes for the States that have RACT regulations, the source category, the VOC emission limit standard if different from the CTG recommendation, and the attainment year for each State.

RACT EXEMPTIONS

Presented in Table C-4 is a list of the VOC emission cutoff levels for State RACT exemptions. These exemptions are listed by affected source categories for each State. The AEROS manual code and estimated affected fraction for each State is listed. These affected fractions must be a minimum of 0.95 to comply with EPA's 5 percent equivalency rule.

BACT DETERMINATIONS

Presented in Table C-5 is a list of BACT determinations as of April 1983 from the BACT/LAER Clearinghouse.² The affected facilities and control level for each source category are listed.

LAER

Presented in Table C-6 is a list of EPA guidance for LAER by source category, as defined in Table A-1 (Appendix A). Also shown are LAER determinations as of April 1983 from the BACT/LAER Clearinghouse.² The affected facilities and control level for each source category are listed.

TABLE C-3. STATE RACT REGULATIONS FOR VOC EMISSIONS IN
NONATTAINMENT AREAS BY SOURCE CATEGORY

Source Category ^a		Coverage Fraction	State AEROS Codes ^b	Emission ^c Limit	Time Frame	
No.	Affected Sources				Start Year	Att. Year
2	Fugitive Emissions From: - Natural Gas Processing - Natural Gasoline Processing	0.88	*	-	86	-
3	Petroleum Liquid Storage - - External Floating Roof Tanks	0.88	26, 38, & 44 4 & 10 15	CTG CTG CTG	81 83 83	- 82 - 85 - 87
3 & 5	VOL Storage: Petroleum Liquids	0.90	*	-	86	- 90
5	Petroleum Storage: Fixed Roof Tanks	0.80	21 23 17, 19, 20, 29, 30, 32, 34, 37, 38, 44, 47, 01, 03, 10, 11, 46 04 05, 06, 07, 08, 09, 14, 15, 18, 22, 26, 31, 33, 36, 39, 41, 42, 45, 48, 49, 51	CTG CTG CTG CTG 5% CTG CTG CTG	80 80 80 80 80 80 80 80	- 80 - 81 - 82 - 82 - 85 - 85 - 87 - 87
8	Petroleum Refinery Equipment Leaks	1.0	19, 26	CTG	83	- 85
9	Misc. Refinery Sources: Wastewater Separators	0.45	31, 36, 38, 39 17, 19, 30, 34, 44, 01, 10, 11, 46 05 06 07 08 14 15 18 23 26 33 45 48 49, 51	CTG CTG CTG 5% 10% 5% CTG CTG CTG CTG CTG CTG 5% CTG	80 80 80 80 80 83 80 80 80 80 80 80 80 80	- 80 - 82 - 85 - 87 - 87 - 87 - 87 - 87 - 87 - 87 - 87 - 87 - 87
10	Misc. Refinery Sources: Vacuum Producing Systems (Distillation)	1.0	38, 45 17, 19, 30, 34, 37, 44 01, 10, 11, 46 05, 06, 08, 14, 18, 23, 36, 33, 26, 15 39, 48, 49, 51 31	CTG CTG CTG CTG CTG 15%	80 80 80 80 80 80	- 80 - 82 - 85 - 87 - 87 - 87
11	Misc. Refinery Sources: Process Unit Turnarounds	1.0	38, 17, 44 19, 30, 34, 37 01, 10, 46 11 05, 08, 15, 18, 23, 26, 33, 36, 39, 45, 48, 49, 51 06, 09, 14, 31, 32	CTG 10% CTG CTG 10% CTG 10% 15%	80 80 80 80 80 80 80 80	- 80 - 82 - 82 - 85 - 85 - 87 - 87 - 87

(continued)

TABLE C-3. (Continued)

Source Category ^a		Coverage Fraction	State AEROS Codes ^b	Emission ^c Limit	Time Frame	
No.	Affected Sources				Start Year	Att. Year
16	Gasoline Bulk Terminals: Tank Truck Transfer	1.0	21 04, 06, 07, 09, 34, 36, 42, 48 29 30 14, 17, 19, 20, 37, 38, 44, 47 32 09 01, 10, 46 11 05 08, 15, 18, 22, 23, 26, 31, 33, 39, 41, 45, 49, 51	CTG CTG 10% 10% CTG 75% 10% CTG 80% 45% CTG CTG	74 80 80 80 80 80 80 80 80 80 80 80	- 74 - 80 - 80 - 80 - 82 - 82 - 83 - 85 - 85 - 87 - 87 - 87
17	Petroleum Bulk Terminals: Other	1.0	9	10%	83	- 87
18	Bulk Gasoline Plants: A - Submerged Fill Required Only	0.50	04, 10 15, 26	CTG CTG	80 80	- 85 - 87
18	Bulk Gasoline Plants: B - Submerged Fill Plus Vapor Tight Trucks Plus Vapor Balance From Storage Tanks to Deliver Supply Vessel	0.50	05, 06	CTG	80	- 87
18	Bulk Gasoline Plants: C - B + Vapor Balance With Account Tank Truck	0.50	21 19, 29, 34, 37, 38, 42, 44 09 01, 46 07, 08, 14, 18, 22, 31, 33, 36, 39, 41, 45 09 23 48, 49	CTG CTG CTG CTG CTG 10% 10% CTG	74 80 80 80 80 83 80 80	- 74 - 82 - 83 - 85 - 87 - 87 - 87 - 87
19	VOL Storage: SOCHI	0.80	*	-	86	- 90
20	Fugitive Emissions From SOCHI (Including Polymers Production of PE, PP, & PS)	0.90	*	-	86	- 90
21	SOCHI: Ethylene Production	1.0	7, 9, 14, & 19	5%	83	- 90
26	SOCHI: Air Oxidation Processes	1.0	*	-	86	- 90
27	High Density Resin Manufacture: PE, PP, & PS	0.75	*	-	86	- 90
32	SOCHI-Transfer of VOC	1.0	9	10%	83	- 90
34	Pharmaceutical Synthesis	1.0	06, 26, 45 42, 49 19, 46 07, 21, 33, 36, 44, 48, 51 39	CTG CTG CTG CTG 15%	81 81 81 81 81	- 82 - 83 - 85 - 87 - 87

(continued)

TABLE C-3. (Continued)

Source Category ^A		Coverage Fraction	State AEROS Codes ^B	Emission ^C Limit	Time Frame	
No.	Affected Sources				Start Year	Att. Year
39	Vegetable Oil Manufacturing	1.0	*	-	-	-
41	Pneumatic Rubber Tire Manufacturing	1.0	37 42 07 15, 34, 36, 39, 44 23 48	5% CTG 37% CTG 30% 10%	81 81 81 81 81 81	- 82 - 82 - 87 - 87 - 87 - 87
42	SBR Co-Polymer Manuf.					
43	Paint Manufacture & Other Coating Manufacturing	0.50	25	50%	83	- 85
54	Kraft Pulp Mills (Same facilities as under NSPS <u>except</u> Brown stack washers vents and BLO vents)	0.50	28	4%	80	- 83
60	Poly Ethylene Bag Sealing Operations	0.10	26	35%	84	- 87
62	Dry Cleaners: Petroleum Solvent	0.98	9	15%	81	- 87
63	Solvent Metal Cleaning (Degreasing) A	1.0	30, 19, 29, 36 07, 15	CTG CTG CTG	80 80 80	- 90 - 82 - 87
63	Solvent Metal Cleaning (Degreasing) B	0.95	21 31, 45 34, 42, 44 01, 03, 10, 11, 46 05, 06, 08, 09, 14, 18, 22, 23, 26, 33, 35, 38, 39, 41, 48, 49 51	CTG CTG CTG CTG CTG CTG CTG	74 80 80 80 80 80 80	- 79 - 90 - 82 - 85 - 87 - 87 - 87
64	Large Appliances Surface Coating	1.0	19 19, 26, 29, 34, 42, 44 01, 03, 10, 11 04 05, 06, 08, 14, 15, 18, 21, 22, 23, 31, 33, 36, 38, 39, 45, 48, 49, 51	40% CTG CTG 30% CTG CTG CTG	80 81 80 83 80 80 80	- 81 - 82 - 85 - 85 - 87 - 87 - 87
65	Magnetic Wire Coating	1.0	19, 26, 30, 34, 42, 44 01, 10, 11, 04 05 06 07, 14, 15, 18, 22, 23, 31, 33, 36, 38, 39, 48, 49, 51	CTG CTG 60% 10% 50% CTG CTG	80 80 83 80 80 80 80	- 82 - 85 - 85 - 87 - 87 - 87 - 87

(continued)

TABLE C-3. (Continued)

Source Category ^a		Coverage Fraction	State AEROS Codes ^b	Emission ^c Limit	Time Frame	
No.	Affected Sources				Start Year	Att. Year
66 - Auto & Light Truck Surface Coating		0.90	17	60%	80	- 82
			05	50%	80	- 85
			08	50%	80	- 85
			22	50%	80	- 85
			01, 05, 06, 11, 14, 15, 17, 19, 21	CTG	80	- 87
			04	40%	83	- 87
			08	25%	80	- 87
			18	15%	80	- 87
			22, 23, 26, 31, 33, 34, 36,	CTG	80	- 87
			38, 39, 44, 45, 48, 49, 51	CTG	80	- 87
67 - Cans Surface Coating		1.0	19, 30, 34, 42, 44, 45	CTG	80	- 82
			01, 03, 04, 10, 11,	CTG	80	- 85
			05	15%	80	- 85
			23	40%	80	- 85
			05	10%	80	- 87
			06, 07, 14, 15, 21, 22, 23, 26	CTG	80	- 87
			18	15%	80	- 87
			31, 33, 36, 38, 39, 48, 49, 51	CTG	80	- 87
68 - Metal Coils Coating		1.0	07	CTG	80	- 80
			19, 26, 34, 42, 44	CTG	80	- 82
			22	50%	80	- 82
			22	36%	80	- 84
			01, 03, 10, 11	CTG	80	- 85
			04	50%	83	- 85
			05	10%	80	- 87
			06, 08, 14, 15, 21, 23, 31, 33	CTG	80	- 87
			18	30%	80	- 87
			36, 38, 39, 45, 48, 49, 51	CTG	80	- 87
69 - Paper Coating		1.0	19, 26, 30, 34, 42, 44, 47	CTG	80	- 82
			20	10%	80	- 82
			41	50%	80	- 82
			01, 10, 11, 41	CTG	80	- 85
			04	30%	83	- 85
			05	10%	80	- 87
			06, 07, 08, 14, 15, 18, 21, 22	CTG	80	- 87
			23, 31, 33, 36, 38, 39, 45, 48	CTG	80	- 87
			49, 51	CTG	80	- 87
70 - Fabrics Surface Coating		1.0	19, 26, 30, 34, 42, 44	CTG	80	- 82
			01, 04, 10, 11,	CTG	80	- 85
			05	10%	80	- 87
			06, 07, 08, 14, 15, 18, 21, 22,	CTG	80	- 87
			31, 33, 36, 38, 39, 41, 45, 48, 49, 51	CTG	80	- 87
			23	25%	80	- 87
71 - Metal Furniture Coating		1.0	42, 44, 19, 26, 30, 34,	CTG	80	- 82
			01, 03, 04, 10, 11	CTG	80	- 85
			45, 48, 49, 51, 06, 07, 08, 14,	CTG	80	- 87
			15, 21, 22, 23, 31, 33, 36, 38,	CTG	80	- 87
			39	CTG	80	- 87
			05	20%	80	- 87
			18	30%	80	- 87

(continued)

TABLE C-3. (Continued)

Source Category ^a		Coverage Fraction	State AEROS Codes ^b	Emission ^c Limit	Time Frame	
No.	Affected Sources				Start Year	Acc. Year
72	Flatwood Paneling Surface Coating	0.80	19, 23, 38, 42, 44	CTG	81	- 82
			04	30%	81	- 85
			10,	CTG	81	- 85
			15, 33, 34, 48, 49, 51	CTG	81	- 87
			31	30%	81	- 87
73	Misc. Metal Parts & Products Surface Coating	0.50	06, 19, 26, 30, 42, 44,	CTG	81	- 82
			04, 46, 51	CTG	81	- 85
			07, 10, 14, 15, 21, 22, 31, 34,	CTG	81	- 87
			36, 38, 39, 48, 49,	CTG	81	- 87
74	Plastic Parts Surface Coating	1.0	4, 26	50%	83	- 85
77	Heavy Duty Coatings on Misc. Surfaces	0.10	26	50%	82	- 85
78	Graphic Arts: Publication Rotogravure Printing	1.0	23, 33, 38, 42, 45	CTG	81	- 82
			26, 30	CTG	81	- 83
			23	20%	81	- 84
			31	CTG	81	- 84
			10, 46	CTG	81	- 85
			06, 14, 15, 19, 21, 22, 34, 37, 39,	CTG	81	- 87
			07	32%	81	- 87
			36	30%	81	- 87
			41, 44, 48, 49, 51	CTG	81	- 87
			05	15%	81	- 87
79	Graphic Arts: Rotogravure Packaging Printing	1.0	44	CTG	81	- 81
			23, 26, 33, 38, 42, 45	CTG	81	- 82
			30	25%	81	- 82
			23	30%	81	- 84
			31	25%	81	- 84
			10, 46	CTG	81	- 85
			06, 14, 15, 19, 21, 34, 37, 39, 41	CTG	81	- 87
			07	42%	81	- 87
			36	20%	81	- 87
			48, 49	CTG	81	- 87
80	Graphic Arts: Other Printing Processes	0.90	30, 31	25%	84	- 87
80	Lithographic Printing	1.0	*	-	-	-
81	Flexographic Printing	1.0	23, 33, 38, 42, 45	CTG	81	- 82
			26	CTG	81	- 83
			30	25%	81	- 83
			23	35%	81	- 84
			31	25%	81	- 84
			14, 46	CTG	81	- 85
			06, 14, 15, 19, 21, 22, 34, 37, 39	CTG	81	- 87
			07	46%	81	- 87
			36	45%	81	- 87
			41, 44, 48, 49	CTG	81	- 87
			51	35%	81	- 87
			05	25%	81	- 87

TABLE C-3. (Continued)

Source Category ^a		Coverage Fraction	State AEROS Codes ^b	Emission ^c Limit	Time Frame	
No.	Affected Sources				Start Year	Att. Year
82	Graphic Arts: Other Printing Processes	0.90	30, 31	25%	84	- 87

^aCategory number from TABLE A-1; coverage fraction estimated from TABLE C-1 comments.

^bSee TABLE C-2 for state names.

^cCTG listed if standard is the same as shown in TABLE C-1.

*No regulations developed, as of July 1984.

TABLE C-4. STATE VOC RACT REGULATION EXEMPTIONS FOR SMALL SOURCES*

AEROS Manual Code	State	VOC Emission Exemption Cutoff, ^a Tons/Year	Affected CTG Source Categories ^b	Estimated State Affected Fraction ^c
01	AL	100	A11	0.95
03 - 07	AZ - CT	NEA	-	1.0
08	DE	7 (40 lbs/day)	64 - I.S.C.: L.A. 66 - I.S.C.: A. & L.T. 68 - I.S.C.: M.C. 70 - I.S.C.: F. & F. 71 - I.S.C.: M.F.	0.98 0.98 0.98 0.98 0.98
09	D.C.	NEA	-	1.0
10	FL	2.5 (15 lbs/day)	A11	0.99
11	GA	100	A11	0.95
14	IL	25	73 78 79	0.97 0.98
		1,000	81	
15	IN	100	A11	0.95
17	KS	100	A11	0.95
18	KY	NEA	-	1.0
19	LA	18 (100 lbs/day)	9-11 - P.R.: Misc. 64 - I.S.C.: L.A. 65 - I.S.C.: M.W. 66 - I.S.C.: A & L.T. 67 - I.S.C.: C. 68 - I.S.C.: M.C. 69 - I.S.C.: P. 70 - I.S.C.: F. & F. 71 - I.S.C.: M.F.	0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.97
20	ME	100	A11	0.95
21	MD	NEA	-	1.0

(continued)

TABLE C-4. (Continued)

AEROS Manual Code	State	VOC Emission Exemption Cutoff, ^a Tons/Year	Affected CTG Source Categories ^b	Estimated State Affected Fraction ^c
22	MA	100	64 - I.S.C.: L.A. 65 - I.S.C.: M.W. 71 - I.S.C.: M.F.	0.95 0.95 0.95
23	MI	NEA	-	1.0
26	MO	100	A11	0.95
28 - 29	NE - NV	NEA	-	1.0
30	NH	100	A11	0.95
31 - 36	NJ - OH	NEA	-	1.0
37	OK	100	16 - G.B.T.: T.T.T. 18 - P.B.P.: T.T.T.	0.95 0.95
38	OR	NEA	-	1.0
39	PA	50	64 - I.S.C.: L.A. 65 - I.S.C.: M.W. 66 - I.S.C.: A. & L.T. 67 - I.S.C.: C. 68 - I.S.C.: M.C. 69 - I.S.C.: P. 70 - I.S.C.: F. & F. 71 - I.S.C.: M.F.	0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.97
41	RI	100	69 - I.S.C.: P. 70 - I.S.C.: F. & F.	0.95 0.95
42	SC	100 (550 lbs/day)	A11	0.95
44	TN	100	A11	0.95
45	TX	100 (550 lbs/day)	A11	0.95
46 - 48	UT - VA	NEA	-	1.0

(continued)

TABLE C-4. (Continued)

AEROS Manual Code	State	VOC Emission Exemption Cutoff, ^a Tons/Year	Affected CTG Source Categories ^b	Estimated State Affected Fraction ^c
49	WA	100 (600 lbs/day)	A11	0.95
51	WI	NEA	-	1.0

^aSources with potential emissions below "cutoff" are exempt from RACT regulations; NEA - no exemptions allowed.

^bSee Table C-1.

^cMinimum of 0.95 to comply with EPA 5 percent equivalency rule.

*The following states do not have VOC RACT regulations: 2, 12, 13, 16, 24, 25, 27, 35, 40, 43, 50, & 52.

TABLE C-5. BACT DETERMINATIONS FOR VOC SOURCES IN
OZONE ATTAINMENT AREAS^a

Source Category ^b	Affected Sources	Overall Emission Reduction	Equivalent Emissions Limit
16	Gasoline Bulk Terminals - Tank Truck Transfer	97.5%	2.5%
24	SOCMI - Maleic Anhydride	90%	10%
25	SOCMI - Ethyl Benzene/Styrene	100%	-
41	Rubber Tire Mfg. (Sealant line)	90%	10%
65	I.S.C. - Magnet Wire (lt. & med.)	90%	10%
	I.S.C. - Magnet Wire (heavy)	95%	5%
67	I.S.C. - Cans (modification)	85%	15%
	I.S.C. - Cans (new)	90%	10%
69	I.S.C. - Paper	95%	5%
70	I.S.C. - Rubber Fabric	90%	10%
78	G.A. - Roto. Pub. Printing	84%	16%
78-79	G.A. - Roto Printing	69-94%	6-31%
80	G.A. - Offset Litho Printing	90%	10%

^aSee Reference 2.

^bSee Table A-1

TABLE C-6. LAER FOR VOC NEW SOURCES IN OZONE NONATTAINMENT AREAS^a

Source Category ^b	Affected Sources	Overall Emission Reduction	Equivalent Emission Limit
1-2	NA		
3-6	Petroleum Liquid Storage Vessels, VP $\geq$ 0.5 PSIA	96%	4%
7	NA		
8	Petroleum Refinery Fugitives	95%	5%
9	Pet. Ref. - Process Drains/Wastewater	90%	10%
10-15	NA		
16	Gasoline Bulk Terminals - Truck Loading	97%	3%
	Gasoline Bulk Terminals - Truck Loading (C.D.)	-	30 mg/L
17-55	NA		
56-59	*		
60-63	NA		
64	I.S.C. - Large Appliances	90%	10%
65	NA		
66	I.S.C. - Auto Coating (C.D.)	90%	10%
67	I.S.C. - Cans	90%	10%
68	I.S.C. - Metals Coils	93%	7%
	I.S.C. - Metal Coils (C.D.)	97%	3%
69	I.S.C. - Paper	85%	15%
	I.S.C. - Paper Labels (C.D.)	99%	1%

(continued)

TABLE C-6. (Continued)

Source Category ^b	Affected Sources	Overall Emission Reduction	Equivalent Emission Limit
70	I.S.C. - Fabrics & Film	85+%	15% Max.
71	NA		
72	I.S.C. - Flat Wood Products	80%	20%
73-77	NA		
78	G.A. - Roto. Pub. Printing (C.D.)	84%	16%
79	G.A. - Roto. Packaging Printing	70%	30%
80	NA		
81	G.A. - Flexographic Printing	65%	35%
	G.A. - Flexographic Printing (C.D.)	85%	15%
82-83	NA		
84-88	*		
89-90	NA		
91-100	*		
101	NA		

NA - Specific control level determination not available.

* - VOC emissions from fuel combustion sources assumed to be exempt from LAER.

^aEmission percentages are EPA guidelines, unless denoted (C.D.) to be from the April 1983 EPA/State agency clearinghouse document. See Reference 2.

^bSee Table A-1.

STATE GENERAL VOC REGULATIONS

Presented in Table C-7 is a list of the States that have a general VOC "photochemical solvent" regulation for sources in both attainment and nonattainment areas. These regulations recognize an assumed difference in the photochemical reactivity of various organic solvents used by industries. The general criteria used to determine a photochemically reactive solvent is:

- Contains more than 20 volume percent ethylbenzene, branched ketones, trichloroethylene, or toluene; or
- Contains more than 8 percent aromatic compounds; or
- Contains more than 5 percent olefinic (unsaturated) compounds.

These regulations require 85 percent VOC control (reduction) for photochemically reactive solvent. However, if nonphotochemically reactive solvents are used, no controls are required.

PSD MAJOR SOURCE CATEGORIES

Presented in Table C-8 is a list of the 28 stationary source industry facilities considered to be major sources of VOC emissions for PSD review. These affected facilities are listed in order of the associated source category from Table A-1 (Appendix A).

TABLE C-7. GENERAL VOC STATE REGULATIONS FOR PHOTOCHEMICAL SOLVENTS

AEROS Manual Code	State	Emission Limit Standard	Comments
05	California	15%	
06	Colorado	15%	
07	Connecticut	15%	
09	D.C.	15%	
14	Illinois	15%	
15	Indiana	15%	
19	Louisiana	10%	
21	Maryland	15%	Applies to sources in nonattainment areas only
34	North Carolina	15%	
35	North Dakota	15%	
41	Rhode Island	15%	Applies to sources that emit <u>less</u> than 100 tons of VOC per year - larger sources must comply with RACT
48	Virginia	15%	

TABLE C-8. CATEGORIES OF MAJOR STATIONARY PSD SOURCES EMITTING
100 TONS OR MORE PER YEAR

Source Category ^a	Affected Sources
3-7	Petroleum storage units with a total capacity exceeding 300 thousand barrels
8-14	Petroleum refineries
15-18	Petroleum transfer units with a total storage capacity exceeding 300 thousand barrels
19-33	Chemical process plants
31	Carbon black plants (furnace process)
33	Charcoal production plants
37	Hydrofluoric acid plants Sulfuric acid plants Nitric acid plants Lime plants Sulfur recovery plants
44-45	Coke oven batteries
44-46	Iron and steel mill plants
47	Primary aluminum or reduction plants Primary copper smelters Primary zinc smelters Primary lead smelters secondary metal production plants
48	Sintering plants
54	Kraft pulp mills
55	Portland cement plants Glass fiber processing plants
60	Coal cleaning plants (with thermal dryers) Phosphate rock processing plants Fuel conversion plants Taconite ore processing plants

TABLE C-8. CATEGORIES OF MAJOR STATIONARY PSD SOURCES EMITTING
100 TONS OR MORE PER YEAR (CONTINUED)

Source Category ^a	Affected Sources
84	Fossil fuel fired steam electric plants of more than 250 million Btu per hour heat input
85	Fossil fuel boilers (or combinations thereof) hour heat input totaling more than 250 million Btu per
*	Municipal incinerators capable of charging more than 250 tons of refuse per day

^aSee Table A-1.

* Nonindustrial source.

REFERENCES

1. U.S. EPA. AEROS Manual Series, Volume V: AEROS Manual of Codes. 2nd ed. EPA-450/2-76-005, update 6. June 1983. Research Triangle Park, NC. pp. 2.10-1.
2. U.S. EPA. BACT/LAER Clearinghouse - A Compilation of Control Technology Determinations (update of EPA-450/2-80-070). April 1983. Research Triangle Park, NC. EPA-450/2-83-005a (NTIS PB83-248419).

APPENDIX D FEDERAL REGULATIONS

Presented in Table D-1 is a list of the VOC NSPS regulations covering stationary industrial sources. These regulations are presented in order of the affected source category as listed in Table A-1 (Appendix A). The table shows the affected facilities within the source category, the proposal date, the VOC emission limit standard, the control techniques expected to be used, the control cost effectiveness (\$/ton VOC reduced) to meet the standard-normalized to a 1980 basis, the source category penetration fraction of the regulation, and any comments from the background information document (BID), Federal Register notices or the Environment Reporter (current developments). Information on regulations under development was obtained by personal communications with EPA's Office of Air Quality Planning and Standards.

An attempt was made to present the emission limit data on a common basis. Where possible, the various forms of standards emission limits were converted to a percentage limit. The conversions are based on assumed typical operating characteristics as described in the reference documents.

The control cost information is presented in the form of ranges. Ranges result from variations in applied control techniques, process characteristics, and economies of scale (i.e., control cost effectiveness is lower for larger sources). The cost values have been normalized to a base year by ratioing the Chemical Engineering cost indices for the year 1980 and the reference year of the model plant cost analysis in the BID. Cost values in parentheses represent cost savings from recovery techniques.

NESHAP

Presented in Table D-2 is a list, by source category, of the VOC NESHAP regulations covering stationary industrial sources. The table shows the affected facilities and target VOC specie, the proposal and promulgation

TABLE D-1. NSPS BY SOURCE CATEGORY

Source Category/ Affected Sources	Proposal Date	VOC Emission Limit ^b	Control Technique ^c	1980 Control Cost, Effectiveness, \$/Ton Reduced	Penetration Fraction ^d	Comments
2 - Onshore processing of natural gas equipment containing more than 1.0 wt. % VOC	Jan. '84	10,000 ppm (22%)	- LDAR - Equip. Specs.	100	1.0	- Emissions would be reduced by 78% over current control means
3 - Petroleum Liquid Storage: more than 40,000 gals. and V.P. $\geq$ 1.0 PSIA	June '73	(5%) (20%)	- INT. Floating Roof - EXT. Floating Roof		0.95	- Floating roof or vapor recovery required, but no specification - Exemptions: Pet. & Cond. prior to custody transfer, fuel oil No. 2-6, gas turbine fuel oil No. 2-4, diesel fuel oil No. 2-4 - FR tanks: 90% external, 10% internal - Typical FR design efficiency: internal - 95% reduction, external - 80% reduction - 95% control required, same exemptions except that "Prior to custody storage" capacity larger than 420,000 gals is covered - Exemption to Pet. & Cond. prior to custody transfer
- Standard Revision	May '78	(5%)	- 2nd seal on EXT. Floating Roof		0.95	
3.5-6 - VOL Storage - Petroleum Liquids: Capacity $\geq$ 4.0 $\times$ 10 ⁶ gals 0.5 - 4.0 $\times$ 10 ⁶ gals	Oct. '84	(4%)	- Floating Roof - Vapor Recovery - Equip. Spec.	100 - 2,200	0.95	- 96% overall control expected - 75,000 = 20,000 gals. - Exemptions: SCC 40300101 is gasoline & 40400301 crude storage at drilling site
8 - Petroleum Refinery - Fugitives: - Pumps, compressors, valves, sample conn. & open ended lines	Jan. '83	10,000 ppm (10%)	- LDAR - Monthly Insp. - Equip. Spec.	200 - 300	1.0	- 83% reduction relative to industry practice of 1980 - Absolute control level about 90%
9 - Refinery Wastewater - Drains - API Separators - DAF Units	May '85	(15%) (20% Avg.)	- Loop Seals - Covers - Capture + C.D.	1,900 1,500 1,100	0.8	- 70% reduction relative to industry practice of 1982 - Drain loop seal - 50% reduced - Covers reduce em. by 85% - Capture & control of DAF units reduces em. by 95%, but minor source - Absolute coverage control level about 80%

(continued)

TABLE D-1. (Continued)

Source Category/ Affected Sources	Proposal Date	VOC Emission Limit	Control Technique ^c	1980 Control Cost, Effectiveness, \$/Ton Reduced	Penetration Fraction	Comments
10 - Distillation Operations: - Petroleum Refineries	Dec. '83	20 ppm (2%)	- Flares - TH. Ox.	2,100	0.4	- Only about 40% of all new and M/R sources to be affected - cost analysis
12 - Asphalt Blowing, Storage, Roofing & Processing	Nov. '80	P.M. Std. only (7%)	- Scrubber		1.0	- 93% of HC emissions reduced w/PM control - Exemptions: storage of cutback & emulsified asphalt
16 - Bulk Gasoline Terminals: - Tank Truck Loading Racks - Capacity >20,000 gals/day	Dec. '80	New: 35 Mg/L Loaded (14%) M/R: 80 Mg/L Loaded (47%)	- Carbon Adsorption - TH.Ox. - Condenser	New 100 - 500 M/R 100 - 1,200	1.0	- New sources - 86% emission reduction over uncontrolled - Many M/R in future - 53% emission reduction over uncontrolled - 1985 emissions would be reduced by 9,000 Mg - Gasoline production constant thru 1990, but old sources replaced or M/R. 1985: 1% - new repl., 4% - M/R, 95% - old production. - 1900: 2% - new replaced., 9% - M/R, 89% - old production, 1511 terminals in 1978
19 - VOL Storage - SOCM: Liquids PSTA Capacity >20,000 gals 0.5' - 4.0' >40,000 gals	Oct. '84	(4%)	- Floating Roof - Vapor Recovery - Equip. Spec.	100 - 2,200	0.8	- Annual SOCM growth rate expected at 5% thru 1988 - 96% overall control expected - 75.3m = 20,000 gals - Assume about 20% of storage exempt
20 - SOCM - Fugitives - Pumps, compressors, valves, sample conn. & open ended lines	Jan. '81	10,000 ppm (13%)	- LDAR - Monthly Insp. - Equip. Spec.	50 - 200	0.99	- 87% overall reduction expected - 1980 emissions at 189,000 Mg - Exemptions: <1,000 Mg VOC/yr

(continued)

TABLE D-1. (Continued)

Source Category/ Affected Sources ^a	Proposal Date	VOC Emission Limit ^b	Control Technique ^c	1980 Control Cost, Effectiveness, \$/Ton Reduced ^d	Penetration Fraction	Comments
21-25 - SOCM Reactor Processes (Carrier Gas)	Apr. '85	20 ppm -2%	- Flares - TH.OX.	2,100	0.2	- 98% control required - 1980 nationwide emissions at 32,000 Mg - 20 year equipment life - Only 4 new sources out of 61 expected will have to add combustion devices - cost analysis
26 - SOCM Air Oxidation - Oxychlorination To E.O.C. etc. - 164 facilities in 1981	Oct. '83	20 ppm -2%	- TH.OX.	2,100	0.19	- 49 new sources expected between '81 & '86 - 57% VOC reduction over SIP reduction of 72% - Only 19% of new sources expected to be affected - cost analysis - Equipment life about 20 years - 6% growth per year - In 1981, 164 sources, 49 in N-A areas - In 1986, uncontrolled emissions would be 78,000 Mg - Pure oxygen processes exempted - 1980 nationwide emissions at 110,000 Mg - 98% overall reduction required
27 - Polymer & Resin Manufacturing: Polymerization Processes - Poly Ethylene - Poly Styrene - Poly Propylene - Poly Esters - Co-Polymers	July '84	2%	- Flares - TH.OX.		1.0	- Processes covered account for 35% of all polymer production - 98% reduction overall from uncontrolled - Of flares already used, NSPS reduces only 13% more emissions - In 1987 42% overall reduction in new source EM, or 3,100 few Mg emissions - Processes exempted: acrylic, phenolic, urea/melamine, ABS/SAN
29 - SOCM Reactor Processes (Carrier Gas)	Apr. '85	20 ppm -2%	- Flares - TH.OX.	2,100	0.2	- 98% control required - 1980 nationwide emissions at 32,000 Mg - 20 year equipment life - Only 4 new sources out of 61 expected will have to add combustion devices - cost analysis

(continued)

TABLE D-1. (Continued)

Source Category/ Affected Sources	Proposal Date	VOC Emission Limit	Control Technique ^c	1980 Control Cost, Effectiveness, \$/ton Reduced	Penetration Fraction ^d	Comments
30 - Distillation Operation: - SOCM ¹	Dec. '83	20 ppm - 2%	- Flares - Th.OX.	2,100	0.4	- Only about 40% of all new, M/R sources to be affected - 1980 SOCM ¹ emissions at 140,000 Mg - 98% control required
35 - Synthetic Fibers Production - Solvent - Spin for more than 500 Mg/yr of fiber	Nov. '82	Acrylic: 10 kg/Mg Feed Non-Ac: 17 kg/Mg Feed (20%)	- Solvent Recovery		0.99	- Assume 80% reduction - Reaction Spin spandex - exempt - Viscose - rayon - exempt - Modifications - exempt - 1987 emissions would be reduced by 8,800 Mg
41 - Rubber Tire Manufacturing: - Michelin AMC: - Other Tires	Jan. '83	35% 25% (30%)	- Carbon Adsorption ⁿ		1.0	- 1979 industry emissions: 58,700 Mg - 30 year plant life - Assume 70% overall control
54 - Kraft Pulp Mills - Digester Vents - Brown Stock Pulp Washers Vent - Multiple Effect Evaporator Vents - Recovery Furnace Flue Gas	Sept. '76		- Melt Dissolving Tank Vent - Lime Kiln Flue Gas - Black Liquor Oxidation Vent - Condensate Stripper Vent		0.5	
62 - Petroleum Solvent Dry Cleaning - Cartridge Filter Plants: - Settling Tank Plants:	Dec. '82	8.5 Kg/100 D.A. 7.5 Kg/100 D.A. (28%)	- Recovery Dryers - Cartridge Filters - Settling Tanks - Work Practice	100 to 400	0.99	- M/R rate at 3.3% for assumed 30 year equipment life - Less than 17.8 Cu. M./Yr solvent consumption - exempted - About 72% overall reduction from both source types - 1980: 230 sources
63 - Solvent Metal Cleaning (Degreasing) - Cold Cleaners - Open Top Vapor Degreases - Conveyorized Degreases	June '80 (1985*)	(21%) 33 to 53% 30 to 50% (36%)	- Covers, Drains - Work Practice - Covers, Work Practice - Covers, Free Board, Carbon Adsorption	(150) 200 (100)	1.0	- 55,000 sources in 1976 * Applicability deferred until 1985 - Overall 64% new source reduction - UNC. E.: 1974 - 725,000 Mg - 1985 1.65 million Mg

(continued)

TABLE D-1. (Continued)

Source Category/ Affected Sources	Proposal Date	VOC Emission Limit	Control Technique ^c	1980 Control Cost Effectiveness, ^d \$/Ton Reduced	Penetration ^e Fraction	Comments
64 - Industrial Surface Coating: Large Appliances	Dec. '80	0.80 Kg/L A.S. (20%)	- 62% Solids Coating - 60% Transfer Efficiency			- 1980: uncontrolled emissions at 20,200 tons; controlled emissions at 4,000 tons - 190 plant sites in 1976 - In 8 states - 80% overall reduction - Line modifications occur every 10-15 years
66 - Auto & Light Duty Truck Surface Coating - Prime - Guide - Top - Standard Revision - Prime	Oct. '79 July '82	Kg/L A.S. 0.16 1.40 0.17 0.17 (12%)	- Waterborne Coating	300 - 3,000	0.9	- Metal components only - plastic components exempt - Trucks less than 3,850 kg - Heavy trucks exempt - 88% overall reduction industry-wide from uncontrolled
67 - Industrial Surface Coating: Beverage Cans - 2pc. Ext. Base Coat - 2pc. Clear Base Coat - 2pc. Inside Spray Coat	Nov. '80	Kg/L A.S. - 0.29 - 0.46 - 0.89 (14%)	- Waterborne Coating	0	0.6	- Assume 86% overall control - 32% more reduction over CIG - Coating lines last more than 20 years before M/R - 1979: Beverage cans 58% of can market
68 - Ind. Surface Coating: Metal Coils - With Control Device - No Control Device	Jan. '81	Kg/L A.S. - 0.14 - 0.28 (10%)	- TH. OX. - Waterborne Coating	100 - 400	1.0	- 90% overall control - continuous metal strips
69 - Ind. Surface Coating: Pressure Sensitive Tapes & Labels Paper Coating - More than 50 Tons 10G/Yr	Dec. '80	0.20 KG/KG A.S. -10%	- Carbon Adsorption - Waterborne Coatings	(100 - 3,300)	0.3	- 50 tons/yr or less - exempt - 90% overall reduction - BTL about 30% of all paper coating

(continued)

TABLE D-1. (Continued)

Source Category/ Affected Sources ^a	Proposal Date	VOC Emission Limit ^b	Control Technique ^c	1980 Control Cost, Effectiveness, \$/Ton Reduced ^d	Penetration Fraction ^e	Comments
70 - Ind. Surface Coating & Printing of Flexible Vinyl Urethane Film on Rotogravure Print Lines - Wall Coverings - Decorative Coverings	Jan. '83	1.0 KG/KG A.S. -15%	- Carbon Adsorption - Low VOC Coating		0.5	- In 1980, uncontrolled emissions at 62,700 Mg, actual emissions at about 21,600 Mg for an average 35% control level - 1987 estimated emissions at 65,800 Mg - 1987 emissions would be reduced by 760 Mg - 85% overall control - Equipment life/30 years - 8% growth rate per yr. for wall covering products, but little growth for other industrial sections thru 1987
70 - Surface Coating of Magnetic Tapes	Apr. '85	(10%)	- Carbon Adsorption		0.1	- About 90% overall control expected - Magnetic tape about 10% of fabric coating category
70 - Elastomeric Coating of Fabrics - Not Printing - Belts, Blankets, Hoses, Tarps, etc.	Sept. '86	(20%)	- Carbon Adsorption		0.4	- 80% overall reduction expected - Assume ECF is about 40% of fabric coating category
71 - Ind. Surface Coating: - Metal Furniture	Nov. '80	0.70 KG/L A.S. (26%)	- 62% Solids Coating - 60% TE	(400)	1.0	- 1980: 113,600 Mg uncontrolled - 37% more reduction over CTG level - 74% overall reduction
73 - Rec. Vehicle Coating	Aug. '86	(40%)	- Waterborne primer - Low VOC Top Coat		0.1	- 60% overall control expected - Assume RVC is about 10% of other metal/wood products category
74 - Plastic Parts Coating - Business Machines	No. '86	(60%)	- Waterborne Coatings		0.2	- Assume plastic-business machine is 20% of category - Business machine parts only - Not plastic auto parts - 40% overall reduction in 1987 - 1,200 fewer Mg from new sources

(continued)

TABLE D-1. (Continued)

Source Category/ Affected Sources ^a	Proposal Date	VOC Emission Limit	Control Technique ^c	1980 Control Cost, Effectiveness, \$/Ton Reduced	Penetration Fraction ^d	Comments
78 - Graphic Arts: - Publication Rotogravure	Oct. '80	16%	- Carbon Adsorption	(4 - 40)	0.99	- Other printing operations - exempt - Proof presses - exempt - 1980 - 168,000 Mg uncontrolled - 41,000 Mg emissions - 1985 - 236,000 Mg uncontrolled - 51,000 Mg emission expected - 84% overall control - new sources
79-82 Graphic Arts: - Printing on paper, Film, & Foil	Aug. '86	(25%)	- Carbon Adsorption - TH.Ox. - Waterborne Coatings		1.0	- All types of presses used: roto, litho, letterpress - Assume 75% overall control based on CIG of 60 to 65%
80 - Graphic Arts: - Offset Lithography	Nov. '86	(25%)	- TH.Ox.			- 75% overall control expected same as for paper, film & foil printing

^aCategory numbers correspond to point source category list in Table A-1; kPa - 0.14 x PSIA; m³ = 0.0038 x Gals.

^bPercentage emission limits in parentheses are calculated equivalents to other standard formats; ppm = parts per million; P.M. = particulate matter; D.A. = Dried Articles; A.S. = Applied Solids.

^cLDAR = Leak detection and repair; C.D. = control device; TH.Ox. = thermal oxidation.

^dAnnualized cost to meet standard emission limit relative to uncontrolled condition - normalized to year 1980; range for size variation of sources and operating characteristics; costs in parentheses represent cost savings from solvent recovery; \$/Mg reduced = 1.1 x \$/ton reduced.

^eFraction of source category affected by regulation.

TABLE D-2. NESHAP BY SOURCE CATEGORY

Source Category/ VOC Specie/Processes ^a	Proposal Date	Final Promulgation Date	VOC Emission ^b Limit Standard ^b	Control Technique ^c	Control Cost Effectiveness, ^d \$/Ton Reduced	Penetration Fraction ^e	Comment
8 - Benzene Fugitives: Petroleum Refineries - Valves - Pumps - Compressors - Process Vessels	Jan. '81	May '84	No emissions allowed (1x)	- LDAR - Equip. Spec's.		0.05	- Assume 99% control - Assume benzene is about 5% of all petroleum VOC fugitives
19 - Benzene Storage of More Than 4 Cu. Meters - Standard Withdrawn	Dec. '80 Mar. '84	May '84	5%	- Floating Roof		0.05	- Assume benzene is 5% of all petroleum VOC fugitives - Coke oven by-product storage - exempt (1,000 gals.) - 95% control required
20 - Benzene Fugitives: SOCHI - Valves - Pumps - Compressors - Process Vessels	Jan. '81	May '84	No emissions allowed (1x)	- LDAR - Equip. Spec's.		0.05	- Assume 99% control - Assume benzene is 5% of all SOCHI VOC fugitives
22 - Acrylonitrile Production - Standard Deleted	Mar. '84	May '84					- 25 plants - EPA to ask states to regulate: few sources & cost impacts
23 - Vinyl Chloride Production: - EDC Processing - Oxidation - VC - PVC Reactors - Latex & Misc. Prod. - Dispersion Prod. - Standard Revision	Oct. '76	June '77 (Apr. '85)	- 10 ppm VC - 0.2 gr/kg Prod. - 10 ppm - 10 ppm W/O Stripper - 0.4 gr/kg - 0.2 gr/kg (6x)			0.99	- Reactors less than 50 gals exempted - Applicability delayed until 1978 - new sources - Overall control about 94%
24 - Benzene Feed for Maleic Acid & Anhydride of more than 500 Mg/yr Prod. - Existing Sources - New Sources - Standard Withdrawn	Apr. '80 Mar. '84	May '84	- 0.30 kg/ 100 kg benzene feed - No emissions allowed (1x)			1.0	- Less than 500 mg/yr - exempt - Substitution of butane for benzene possible - Industry capacity utiliza- tion: '78 at 50% '82 at 100% - 5,800 Mg/yr

(continued)

TABLE D-2. (Continued)

Source Category/ VOC Specter/Processes	Proposal Date	Final Promulgation Date	VOC Emission Limit Standard ^b	Control Technique ^c	Control Cost ^d Effectiveness, \$/Ton Reduced	Penetration Fraction	Comment
25 - Benzene from Ethyl- benzene/Styrene Processes - Standard Withdrawn	Dec. '80 Mar. '84	May '84 May '84	5 ppm or 1%	- Condensers - Scrubbers - Flares	(200)	1.0	- Existing production under utilized - No new capacity until 1985 - 99% of EG goes to styrene
44 - Coke Oven Emissions - Door Leaks - Direct Oven Emissions - Hazardous Organics (w/o Benzene) - Wet Coal Charged Oven Batteries	(1985)		Work Practice Standard			1.0	
45 - Benzene from Coke Ovens/By-Product Recovery Processes: - Process - Storage - Fugitives	June '84	(July '85)	- Equipment Standard - Work Practice Standard - 23% - All VOC - 12% - Benzene			1.0	- 42 plants in 1984 - Overall result: 88% benzene reduction; 77% all VOC's reduction - 1984 VOC emissions at 24,000 MG - About 98% process emissions reduction - About 90% storage emissions - About 90% fugitive emissions

^aCategory numbers correspond to point source category list in Table A-1; m³ = 0.0038 x Gals.

^bPercentage emission limits in parentheses are calculated equivalents to other standard formats; ppm = parts per million.

^cLDAR = leak detection and repair; C.D. = control device; TH.OX. = thermal oxidation.

^dAnnualized cost to meet standard emission limit relative to uncontrolled condition - normalized to year 1980; range for size variation of sources and operating characteristics.

^eFraction of source category affected by regulation.

(final) dates, the VOC species emission limit standard, the control techniques expected to be used, the control cost effectiveness (\$/ton VOC reduced) to meet the standard, the source category penetration fraction, and any comments. Information on regulations under development, emission limit standards, and control costs were handled as for NSPS regulations.

APPENDIX E

SUMMARY OF VOC CONTROL COSTS

As a result of regulatory development, category specific cost data are available for about half of the 90 industrial categories used in the VOC model. Regulatory support documents such as Background Information Documents (BICs), Control Technique Guideline Documents (CTGs), Federal Register (FR), and other EPA documents were reviewed for cost data. The reference year for cost effectiveness varied for the different documents. In general, the Gross National Product (GNP) Deflator Indices were used to adjust cost effectiveness to 1980 dollars.

The general approach for developing cost effectiveness/emission reduction values from data presented in the BIDs, CTGs, etc., was to first verify the basis for cost effectiveness presented. The cost effectiveness in BIDs often represents going from an already controlled baseline to a higher level of control. For the purpose of the VOC Model, cost effectiveness represents going from no control to a specified control level for the entire category. Where cost effectiveness values did not represent an "absolute" (from no control) cost effectiveness, available cost and emission reduction data were used to develop an absolute cost effectiveness. In a number of documents, overall (or industry average) cost effectiveness and percent emission reduction were presented for several regulatory alternatives. In this case, cost effectiveness and emission reduction values could be simply extracted and used in the VOC Model.

Other documents presented cost effectiveness and control efficiencies for various controls applied to different facility types. In this case, it was assumed that the most cost effective controls would be implemented first. Cost effectiveness cutoffs were selected and an average cost effectiveness and category percent emission reduction were calculated. Whenever possible, the average cost effectiveness was weighted by the emission reduction achievable. This was not possible for some categories and only the numerical average could be calculated.

TABLE E-1. VOC CONTROL INPUT FILES

Industrial Category	1980 Uncontrolled Emissions (tons)	1980 Level Of Control (%)	Control	Emission Red. (\$)	Cost Effectiveness (\$/Mg)		Data Source
					New	Retrofit	
1. On-Shore Crude Oil Production	13,139	0	Quarterly LDAR + Cap open-end lines Monthly LDAR + Caps + Sample connections + control compressor vents Monthly LDAR + Caps + Sample connections + compressor controls + rupture disc + dual seal pumps	71 72 77	65 79 430	65 79 490	BID
2. On-Shore Natural Gas Production	7,159	83.7	Quarterly LDAR + Cap open-end lines Monthly LDAR + Caps + Sample connections + control compressor vents Monthly LDAR + Caps + Sample connections + compressor controls + rupture disc + dual seal pumps	71 72 77	65 79 430	65 79 490	BID
3.44. Petroleum Liquid Storage > 1.5 psia Floating Roof - Standing Loss + Withdrawal Loss	904,467	77.9	Baseline - Int. floating roof, primary vapor mounted seal, bolted deck Liquid mounted primary seal Liquid mounted primary + controlled fittings Liquid mounted primary + secondary controlled fittings Welded deck, liquid mounted primary + secondary seal, controlled fittings	93.4 94.6 96.2 96.6 97.3	-233 -196 -199 -167 -13	-158 -120 -124 -91 -70	BID
5. Petroleum Liquid Storage > 1.5 psia Fixed Roof	543,530	58.2	Baseline - Int. floating roof, primary vapor mounted seal, bolted deck Liquid mounted primary seal Liquid mounted primary + controlled fittings Liquid mounted primary + secondary controlled fittings Welded deck, liquid mounted primary + secondary seal, controlled fittings	93.4 94.6 96.2 96.6 97.3	-233 -196 -199 -167 -13	-158 -120 -124 -91 -78	BID
6. Petroleum Liquid Storage ≥ 0.5 psia	392	12.5	Baseline - Int. floating roof, primary vapor mounted seal, bolted deck Liquid mounted primary seal Liquid mounted primary + controlled fittings Liquid mounted primary + secondary controlled fittings Welded deck, liquid mounted primary + secondary seal, controlled fittings	93.4 94.6 96.2 96.6 97.3	52 160 151 244 692	269 380 367 464 933	BID

TABLE E-1. VOC CONTROL INPUT FILES (Continued)

Industrial Category	1980 Uncontrolled Emissions (tons)	1980 Level Of Control (%)	Control	Emission Red. (%)	Cost Effectiveness (\$/Mg)		Data Source
					Now	Retrofit	
7. Petroleum Liquid Storage < 0.5 psi	2,763,900	95.0	Baseline - Int. floating roof, primary vapor mounted seal, bolted deck Liquid mounted primary seal Liquid mounted primary + controlled fittings Liquid mounted primary & secondary seal + controlled fittings Welded deck, liquid mounted primary & secondary seal, controlled fittings	93.4 94.6 96.2 96.6 97.3	1,621 2,108 2,070 2,512 4,578	2,620 3,118 3,064 3,528 5,690	BID
8. Petroleum Refineries - Fugitives: Benzene & Other VOC	239,989	50.0	Quarterly LDAR for gas valves & compressors + yearly LDAR for pumps, liquid valves & drains + cap open lines. Monthly LDAR + rupture disks + cap open lines + closed-loop sampling Monthly LDAR + dual seal pumps + rupture disks + caps + closed-loop sampling + mechanical seal compressors Dual seal pumps + diaphragm or sealed bellows valves + rupture disk + caps + enclosed drains + closed-loop sampling + mechanical seal compressors	57 73 77 90	-110 100 430 3,600	-85 170 520 5200	BID
9. Petroleum Refineries - Process Drains/Waste Water	148,309	20.5	Cover oil-water separators Collection & control for oil water separators Gas tight IAF + P - traps on all drains & seal pots on junction boxes + collection & control for oil-water separators + cover for DAF systems Sealed drain system vented to control device + gas tight IAF + collection & control for oil-water separator + fixed cover for DAF Collection & control on IAF, DAF, oil-water separator, and drain systems	48 55 77 96 97	32 200 220 880 1,200	50 220 330 970 1,290	BID
10. Petroleum Refineries - Distillation Operations	797,274	95.7	Vent to existing firebox	98	-140	-130	CTG

TABLE E-1. VOC CONTROL INPUT FILES (Continued)

Industrial Category	1980 Uncontrolled Emissions (tons)	1980 Level of Control (%)	Control	Emission Red. (%)	Cost Effectiveness (\$/Mg)		Data Source
					Now	Retrofit	
11. Petroleum Refineries - Process Unit Blowdown	56,081	66.9	Vent to existing flare	98	5	6	CTG
12. Petroleum Refineries - Asphalt Processing: Blowing, Roofing, Concrete	66,915	44.6	Incinerator	99	160	330	NAPAP/OCM
13. Petroleum Refineries - Lub Oil Manufacturing	2,857	0.0	Vent to existing flare	98	5	6	NAPAP/CTG
14. Petroleum Refineries - Others	2,199,176	93.9	Vent to existing flare	98	5	6	NAPAP/CTG
15. Petroleum Marketing - Ship/Barge/Tanker Vessels	115,434	74.8	Condenser Condenser Condenser	50 80 95	95 -32 -39	170 14 5	NAPAP/OCM
16. Gasoline Bulk Terminals - Tank Truck Transfer	339,708	54.4	Carbon adsorber control	95	350	460	EPA Document
17. Petroleum Bulk Terminals - Others Transfer	26,321	45.5	Condenser Condenser Condenser	50 80 95	95 -32 -39	170 14 5	NAPAP/OCM
18. Petroleum Bulk Plants - Tank Truck	335	0.0	Vapor balance	95	360	410	EPA Document

TABLE E-1. VOC CONTROL INPUT FILES (Continued)

Industrial Category	1980 Uncontrolled Emissions (tons)	1980 Level of Control (%)	Control	Emission Red. (%)	Cost Effectiveness (\$/Mg)		Data Source
					New	Retrofit	
19. SOCMI-VOL Storage	2,197	91.4	Baseline - Int. floating roof, primary vapor mounted seal, bolted deck Liquid mounted primary seal Liquid mounted primary + controlled fittings Liquid mounted primary & secondary seal + controlled fittings Welded deck, liquid mounted primary & secondary seal, controlled fittings	93.4 94.6 96.2 96.6 97.3	-233 -196 -199 -167 -13	-158 -120 -124 -91 -70	BID
20. SOCMI-Fugitives: Benzene & Other VOC	1,925	69.9	Control degassing vents Monthly LDAR for pumps, valves & pressure relief devices + control degassing vents Rupture disks + caps on open-end lines + closed-loop sampling + monthly LDAR + control degassing vents Dual mechanical pump seals + rupture disks + caps on open-end lines + closed-loop purge + monthly LDAR + control degassing vents.	3.5 44.5 57.5 61.9	-120 250 380 760	-120 250 640 1,060	BID/ FR Notice
21. SOCMI - Ethylene Production	313,862	93.6	Incinerator or flare Incinerator or flare Incinerator or flare Incinerator or flare Incinerator or flare	13 88 89 95 98	420 1,400 1,500 1,800 2,400	550 1,800 2,000 2,300 3,000	BID
22. SOCMI - Acrylonitrile Production	262,600	96.8	Incinerator or flare Incinerator or flare Incinerator or flare Incinerator or flare Incinerator or flare	13 88 89 95 98	420 1,400 1,500 1,800 2,400	550 1,800 2,000 2,300 3,000	BID
23. SOCMI - Vinyl Chloride/EDC/PVC Production	322,628	93.8	Vinyl Chloride NESMAP Controls	95	2,400	3,100	FR Notice
24. SOCMI - Maleic Acid/Anhydride Production	3,387	87.3	Thermal oxidizer w/heat recovery Thermal oxidizer w/heat recovery	97 99	480 634	480 634	BID
25. SOCMI - Ethyl Benzene/Styrene Production	37,672	97.5	Flare or thermal oxidation Flare or thermal oxidation Flare or thermal oxidation Flare or thermal oxidation	13 88 89 95 98	420 1,400 1,500 1,800 2,400	550 1,800 2,000 2,300 3,000	BID

TABLE E-1. VOC CONTROL INPUT FILES (Continued)

Industrial Category	1980 Uncontrolled Emissions (tons)	1980 Level of Control (%)	Control	Emission Red. (%)	Cost Effectiveness (\$/Mg)		Data Source
					New	Retrofit	
26. SOOMI - Air Oxidation Reactor Processes	223,624	95.6	Flare or thermal oxidation Flare or thermal oxidation Flare or thermal oxidation Flare or thermal oxidation Flare or thermal oxidation	31 46 57 66 81 98	510 770 940 1,100 1,800 3,500	590 880 950 1,300 2,100 4,000	FR Notice
27. SOOMI - Polyesters & Co-Polymers: PES, PE, PS & PP	2,814,950	98.0	Condenser control at polystyrene plants Condenser control at PS plants + flare at HDPE plants + PP plants	3 98	-450 1	-415 3	CTG
28. SOOMI - Polymers & Co-polymers: Others	23,951	95.8	Gas Scrubber	99	480	590	NAPAP/OCM
29. SOOMI - Other Reactor Processes	648,604	95.7	Flare or thermal oxidation Flare or thermal oxidation Flare or thermal oxidation Flare or thermal oxidation Flare or thermal oxidation	13 88 89 95 98	420 1,400 1,500 1,800 2,400	550 1,800 2,000 2,300 3,000	BID
30. SOOMI - Distillation Operations	3,963	20.0	Flare or thermal oxidation Flare or thermal oxidation Flare or thermal oxidation Flare or thermal oxidation Flare or thermal oxidation Flare or thermal oxidation	38 52 65 72 78 82 86 88	27 48 120 160 170 240 310 360	35 62 160 210 220 310 400 470	FR Notice
31. SOOMI - Carbon Black Production	216,435	28.1	Flare	90	60	70	EPA Document
32. SOOMI - Transfer/Marketing: Truck & Rail Cars	186,767	29.1	Incinerator Incinerator	99 98	140 160	190 330	NAPAP/OCM
33. SOOMI - Other: Charcoal, Wastewater, Misc.	7,929,760	95.0	Condenser Condenser Condenser	50 80 95	95 -32 -39	170 14 5	NAPAP/OCM
34. Pharmaceutical Synthesis	80,537	97.3	Incinerator	98	160	330	NAPAP/OCM

TABLE E-1. VOC CONTROL INPUT FILES (Continued)

Industrial Category	1980 Uncontrolled Emissions (tons)	1980 Level Of Control (%)	Control	Emission Red. (%)	Cost Effectiveness (\$/Mg)		Data Source
					New	Retrofit	
35. Synthetic Fiber Manufacture - Solvent Spin	131,640	86.5	Dryer solvent recovery Spin cell enclosure/capture + dryer solvent recover Capture at all post spinning fiber processing stages + dryer solvent recovery	96 97.6 98.5	0 5 3	30 12 8	BID
36. Synthetic Fiber Manufacture: Others	336,591	93.4	Condenser Condenser Condenser	50 80 95	95 -32 -39	170 14 5	NAPAP/ OCM
37. Inorganic Chemical Manufacture	54,184	53.1	Incinerator	99	160	180	NAPAP/ OCM
38. Fermentation Processes: Alcohol Products	26,177	0.6	Gas Scrubber	99	480	590	NAPAP/ OCM
39. Vegetable Oil Processing	1,021,600	99.0	Mineral oil scrubber for extractor and replacement of desolventizer	83	-90	-60	CTG
40. Plastic Products Manufacture	7,723	9.8	Incinerator	99	180	330	OCM
41. Rubber Tire Manufacture	304,360	96.0	Carbon adsorber Carbon adsorber + better capture + water based green tire spray	67 78	910 870	1,100 980	BID
42. Synthetic Rubber Manufacture	650,732	85.0	Condenser Condenser Condenser	50 80 95	95 -32 -39	170 14 5	NAPAP/ OCM
43. Other Chemical: Soaps/Det., Explosives, Coating, Agr.	238,115	85.4	Condenser Condenser Condenser	50 80 95	95 -32 -39	170 14 5	NAPAP/ OCM
44. Iron & Steel Manufacture - Coke Ovens	73,407	20.7	Incinerator	99	160	330	NAPAP/ OCM
45. Iron & Steel Manufacture - Coke Oven By-Product	0	0.0	Incinerator	99	180	330	OCM
46. Iron & Steel Manufacture - Others	12,691	4.4	Incinerator	99	180	330	OCM

TABLE E-1. VOC CONTROL INPUT FILES (Continued)

Industrial Category	1980 Uncontrolled Emissions (tons)	1980 Level of Control (%)	Control	Emission Red. (%)	Cost Effectiveness (\$/Mg)		Data Source
					New	Retrofit	
47. Primary/Secondary Metals & Electrical	56,362	53.3	Incinerator	95	160	330	NAPAP/ OCM
48. Secondary Metals - Heat Treating	0	0.0	Incinerator	99	160	330	OCM
49. Fabricated Metal Products	18,351	12.3	Condenser Condenser	50 80 95	95 -32 -39	170 14 5	NAPAP/ OCM
50. Tobacco Products	1,913	0.0	Incinerator	99	160	330	OCM
51. Food Products	235,733	92.7	Incinerator	99	160	330	NAPAP/ OCM
52. Textile Mill & Leather Products	158,970	82.0	Carbon Adsorber	79	60	130	NAPAP/ OCM
53. Lumber and Wood Products	21,265	3.2	Incinerator	99	160	330	OCM
54. Paper and Allied Products	25,933	11.2	WSPS controls: Incinerator & combustion control	99	160	330	NAPAP/ OCM
55. Mineral Products - Stone, Clay, Glass	153,369	33.4	Incinerator	99	160	330	NAPAP/ OCM
56. In-Process Fuel Use - Coal	1,015	2.5	Incinerator	99	160	330	OCM
57. In-Process Fuel Use - Fuel Oil	27,291	67.6	Incinerator	99	160	330	NAPAP/ OCM
58. In-Process Fuel Use - Process and Natural Gas	139,549	47.0	Incinerator	99	160	330	NAPAP/ OCM

TABLE E-1. VOC CONTROL INPUT FILES (Continued)

Industrial Category	1980 Uncontrolled Emissions (tons)	1980 Level of Control (%)	Control	Emission Red. (%)	Cost Effectiveness (\$/Mg)		Data Source
					New	Retrofit	
59. In-Process Fuel Use - Other: Coke, Wood, Waste, etc.	36,823	86.7	Incinerator	99	160	330	NAPAP/ OCM
60. Other Industrial Processes: Mining & Misc.	442,980	47.3	Gas Scrubber	99	480	590	NAPAP/ OCM
61. Adhesives Manufacture	2,705	44.7	Incinerator	99	160	330	OCM
62. Dry Cleaning - Petroleum Solvent	10,632	2.5	Recovery dryers	69	-300	-400	BID/ CTG
63. Organic Solvent Metal Cleaning and Degreasing	165,024	24.4	Refrigerated freeboard chiller for conveyORIZED degreasers	9	-300	-290	CTG
			Cover & 0.75 FBR for OTVD + RFC for conveyORIZED degreaser	23	-295	-280	
			Cover above freezing FBC for OTVD + RFC for conveyORIZED degreaser	25	-110	-57	
			Cover, 0.7 FBR, & drain for cold cleaners + cover above freezing FBC for OTVD + RFC for conveyORIZED degreasers	37	-73	0	
			Carbon adsorber for conveyORIZED degreasers + cover, 0.7 FBR, & drain for cold cleaners + cover above freezing FBC for OTVD	36	140	65	
			Adsorber drying tunnel for conveyORIZED degreaser + cover, 0.7 FBR, & drain for cold cleaners + cover above freezing FBC for OTVD	40	170	290	
			Cover & carbon adsorber for OTVD + adsorber drying tunnel for conveyORIZED degreasers + cover, 0.7 FBR, & drain for cold cleaners	43	1,080	1,320	

TABLE E-1. VOC CONTROL INPUT FILES (Continued)

Industrial Category	1980 Uncontrolled Emissions (tons)	1980 Level of Control (%)	Control	Emission Red. (%)	Cost Effectiveness (\$/Mg)		Data Source
					Now	Retrofit	
64. Industrial Surface Coating - Large Appliances	0	0.0	Incinerator	99	160	330	OCM
65. Industrial Surface Coating - Magnet Wire	0	0.0	Incinerator with heat recovery	90	210	230	CTG
66. Industrial Surface Coating - Auto & Light Truck	729	60.1	Waterborne prime, guide, & top coat	84	2,020	2,240	BID
			Waterborne prime coat + incinerator control for top coat	83	3,800	4,120	
			Waterborne prime coat + incinerator control for top & guide coat	91.5	4,480	4,170	
67. Industrial Surface Coating - Cans	34,257	4.1	Waterborne coating - CTG	61	-1,200	-1,200	BID
			Waterborne coating - NSPS	73	-1,000	-1,000	
			Waterborne coating + no-varnish inks Thermal oxidizer + no-varnish inks	77 83	-2,300 -1,500	-2,300 -900	
68. Industrial Surface Coating - Metal Coils	9,949	94.7	Multiple zone incinerators + coat rooms	64	-77	-37	BID
			Thermal incinerator with heat recovery	85	152	200	
			Thermal incinerator with heat recovery + coating rooms	95	177	230	
69. Industrial Surface Coating - Paper	20,384	17.3	Low solvent coating	78.3	1,080	1,160	BID
			Control of oven emissions	85	1,000	1,080	
			Oven & Fugitive emissions control	90	930	1,030	
70. Industrial Surface Coating - Fabric & Films	16,324	10.5	Capture and carbon adsorption control	65	19	150	BID
			Capture and carbon adsorption control	75	-22	100	
			Capture and carbon adsorption control	85	-47	70	

TABLE E-1. VOC CONTROL INPUT FILES (Continued)

Industrial Category	1980 Uncontrolled Emissions (tons)	1980 Level of Control (%)	Control	Emission Red. (%)	Cost Effectiveness (\$/Mg)		Date Source
					New	Retrofit	
71. Industrial Surface Coating - Metal Furniture	458	0.0	65% solids coatings 60% solids + thermal oxidizer 70% solid coatings Waterborne coatings Powder coatings	65 70 72 81 99	0 540 -1,080 2,000 3,200	540 320 430 2,900 5,400	BID
72. Industrial Surface Coating - Flat Wood Products	1,105	0.0	Waterborne system UV-curable coatings for filler and top coat with waterborne basecoat	60 68	310 330	316 343	CTG
73. Industrial Surface Coating - Other Metal/Wood Products	1,489	3.8	Incinerator w/heat recovery	95	230	270	EPA Document
74. Industrial Surface Coating - Plastic Parts: Business Machines & Others	5,186	0.0	Incinerator w/heat recovery	95	230	270	EPA Document
75. Industrial Surface Coating - Large Ships	283	0.0	None Applicable	0	0	0	
76. Industrial Surface Coating - Large Aircraft	88	39.8	None Applicable	0	0	0	
77. Industrial Surface Coating - Handling Coating Solvent, Fugitives, and Others	2,427,724	51.0	Incinerator w/heat recovery	95	230	270	EPA Document

TABLE E-1. VOC CONTROL INPUT FILES (Continued)

Industrial Category	1980 Uncontrolled Emissions (tons)	1980 Level of Control (%)	Control	Emission Red. (\$)	Cost Effectiveness (\$/Mg)		Data Source
					New	Retrofit	
78. Graphic Arts - Rotogravure Publication Printing	0	0.0	84% capture and 90% control device efficiency (dryer control)	75	-100	-40	BID
			85% capture and 95% control device efficiency (dryer control only)	80	-101	-44	
			90% capture and 95% control device efficiency (dryer & fugitive control)	85	-66	7	
79. Graphic Arts - Rotogravure Packaging Printing	64,935	44.3	Control of dryer exhaust by incineration	65	820	990	CTG
80. Graphic Arts - Offset Lithography Printing	25,533	21.3	Substitute lower volatility organics in fountain solution	61	0	0	CTG
			Substitute fountain solution plus cooler/ESP on press dryer	77	610	750	
			Substitute fountain	95	710	880	
81. Graphic Arts - Flexographic Printing	7,644	0.3	Control of dryer exhaust by incineration	60	820	990	CTG
82. Graphic Arts - Other: Letterpress, Other Gravure, etc.	212,566	34.2	Carbon Adsorber	79	60	130	NAPAP/OCM
83. Misc. Solvent Use: Dying & Extraction & Fugitives	130,383	98.1	Carbon Adsorber	99	-46	-16	NAPAP/OCM
84. Utility Boilers	36,043	0.0	None Applicable				
85. Industrial Boilers	192,665	22.8	None Applicable				
86. Industrial Space Heaters	3,974	0.0	None Applicable				

TABLE E-1. VOC CONTROL INPUT FILES (Continued)

Industrial Category	1980 Uncontrolled Emissions (tons)	1980 Level Of Control, (%)	Control	Emission Red. (\$)	Cost Effectiveness (\$/Mg)		Data Source
					New	Retrofit	
87. Stationary Internal Combustion	133,862	5.3	None Applicable				
88. Solid Waste Disposal - Industrial	48,456	19.1	Not Applicable				
89. Waste Solvent Recovery	18	0.0	Incinerator	99	160	330	OCM
90. Not Classified - Misc.	117,701	53.8	Incinerator	99	160	330	OCM
91. Industrial Anthracite Coal	0	0.0	Not Applicable				
92. Industrial Bituminous Coal	549	0.0	Not Applicable				
93. Industrial Coke	1	0.0	Not Applicable				
94. Industrial Distillate Oil	416	0.0	Not Applicable				
95. Industrial Residual Oil	181	0.0	Not Applicable				
96. Industrial Natural Gas	710,752	0.0	Not Applicable				
97. Industrial Wood	123	0.0	Not Applicable				

TABLE E-1. VOC CONTROL INPUT FILES (Continued)

Industrial Category	1980 Uncontrolled Emissions (tons)	1980 Level Of Control (\$)	Control	Emission Red. (\$)		Cost Effectiveness (\$/Mg)		Data Source
				Now	Retrofit	Now	Retrofit	
98. Industrial Process Gas	2	0.0	Not Applicable					
99. Industrial Onsite Incineration	6,119	0.0	Not Applicable					
100. Industrial Open Burning	7,424	0.0	Not Applicable					
101. Solvent Purchased	4,307,413	6.9	Not Applicable					